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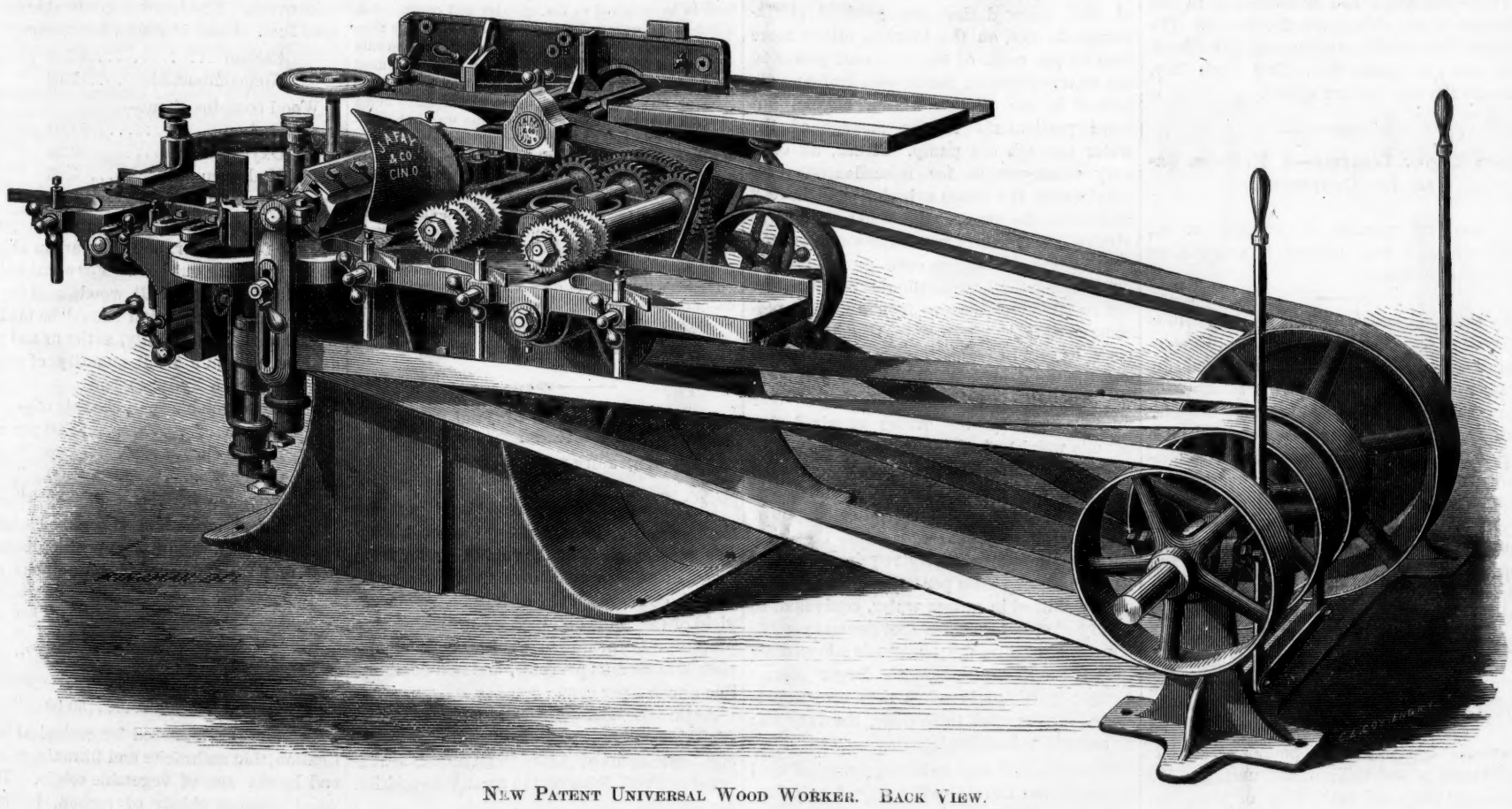
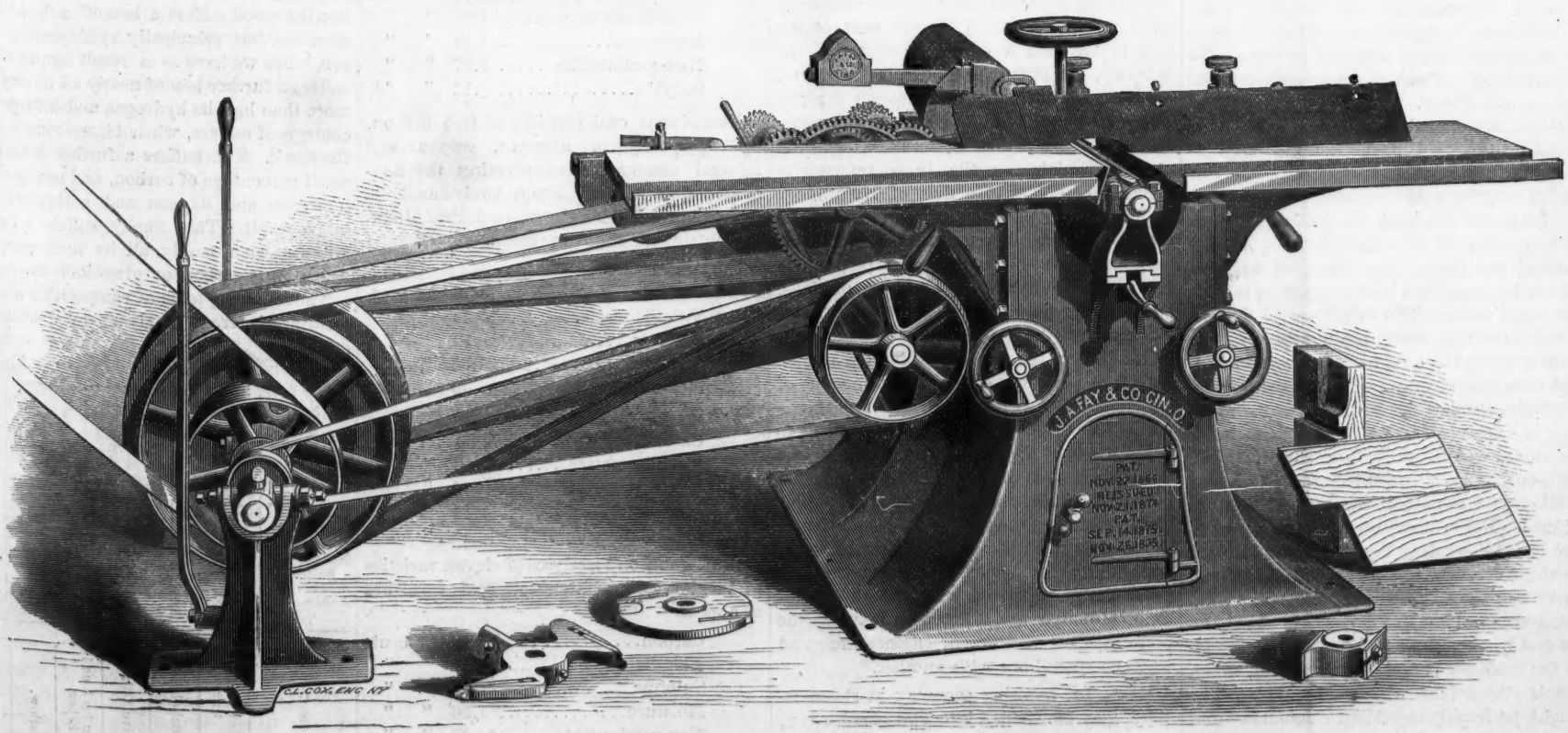


NEW PATENT UNIVERSAL WOOD WORKER. BACK VIEW.



NEW PATENT UNIVERSAL WOOD WORKER. FRONT VIEW.

New Patent Universal Wood Worker.

Herewith is illustrated J. A. Fay & Co.'s No. "D" Solid Frame Patent Universal Wood Worker. It embraces all the essential features of the original Clymer and Riley patent and its reissue, together with the recent improvements originated by J. A. Fay & Co., and secured by letters patent. After having thoroughly tested their capabilities, the manufacturers claim they have no hesitancy in saying they believe them to be one of the most important and valuable wood-working machines extant.

They are constructed in two varieties to work either one, two, three, or four sides, with separate arbors and outside bearing supports upon each side; also with the main arbor extending from one side to the other, with the patent outside bearing supports.

Among the many purposes to which they are adapted is planing straight or out of wind, tapering, rabbeting door and window frames, rabbeting and facing inside blinds, jointing, beveling, chamfering, plowing, making glue joints, raising panels, ripping, cross-cutting, tenoning, circular molding, dovetailing, etc. The form and manner of casting the frame in one piece makes it very strong and substantial, and insures stability and permanency.

Both sides of the machine are driven from one countershaft, arranged so as to convey to both sides simultaneously or separately, as the operator may desire. This method of obtaining independence of the combination allows the operator to perform the work on either side without interfering with the other, and either side may be started or stopped without affecting the other. This is accomplished by means of a double friction pulley upon the countershaft, carrying two belts and operated by two levers.

These machines can be furnished in five different sizes. They are for sale by The George Place Machinery Agency, 121 Chambers and 103 Reade Sts., New York City, who are the sole eastern agents.

Steam Engine Economy—A Uniform Basis for Comparison.

A PAPER BY CHARLES E. EMERY, M. E., MEMBER OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

In writing a general report on the exhibits referred to the judges of Group XX, Centennial Exhibition, the writer compared the facts available in regard to the economy of steam-engines of various kinds on the uniform basis that the boiler is capable of absorbing 10,000 heat-units per pound of coal consumed. This corresponds to an evaporation of 8.99 pounds of water at 80 pounds pressure, 9.03 pounds at 60 pounds pressure, or, 9.08 pounds at 40 pounds pressure from a temperature of 100° in each case. This evaporation is higher than is usually obtained, but has been so much exceeded in practice that it is not considered too high for a basis of comparison. The basis, morever, enables the duty of pumping-engines and other steam machinery to be ascertained and expressed in a very ready and convenient manner. Ten thousand heat-units per pound of coal is equivalent to one million heat-units per 100 pounds of coal, and as the duty of pumping-engines is conventionally expressed in millions of foot-pounds per 100 pounds of coal, it follows on the basis presented that *the number of foot-pounds per heat-unit represents also the number of millions of foot-pounds duty per* 100 *pounds of coal.* The performance of all kinds of steam-engines may be readily compared on this basis. The simplest application is in testing vacuum-pumps, the duty of which may be readily ascertained by noting the height of lift, and the initial and final temperatures of the water lifted. All the heat of the steam not expended in work enters the water, and the work performed lifts the same water. The difference in temperature gives very nearly the number of heat-units imparted to each pound of water lifted, and each pound of water so heated is lifted a certain number of feet high, so the result may be expressed readily in foot-pounds per heat-unit, which, as before stated, equals also, on the basis presented, the number of millions of foot-pounds duty per 100 pounds of coal. For ordinary comparisons the number of millions duty equals the lift divided by the difference between the initial and final temperatures of the water. For more accurate computations, the divisor should be increased by the number of heat-units expended for work per pound of water lifted, which equals the height divided by 772. The height preferably should be calculated from the indications of a pressure-gauge at the bottom of the discharge-pipe, so as to include frictional resistances. If D=duty in foot-pounds per 100 pounds of coal, H=the height of lift per guage, and t and T=the initial and final temperatures respectively, then

$$D=\frac{1\,000\,000\ H}{T-t+.0013\ H.}$$

Arrangements have been made by the writer to use the same basis in testing pumping-engines, by discharging water from the hot well into the suction of the main pumps, and noting with delicate thermometers the resulting increase of temperature of the water lifted.

A vacuum-pump tested by the writer in 1871 gave a duty, on the above basis, of $4\frac{7}{10}$ millions; one tested by Mr. J. F. Flagg at the Cincinnati Exhibition in 1875, reduced to the same basis, gave a maximum duty of $3\frac{25}{100}$ millions. Several vacuum and steam-pumps tested on this basis at the suggestion of the writer about two years since, gave duties reported as high as 10,000-000 to 11,000,000, the very small steam-pumps doing no better apparently than the vacuum-pumps, which is by no means surprising. Elaborate experiments made with steam-pumps at the American Institute Exhibition of 1867, showed that average-sized steam-pumps do not, on the average, utilize more than 50 per cent. of the indicated power in the steam-cylinders, the remainder being absorbed in the friction of the engine, but more particularly in the passage of the water through the pump. Again, all ordinary steam-pumps for miscellaneous uses require that the steam-cylinder shall have 3 to 4 times the area of the water-cylinder to give sufficient power when the steam is accidentally low; hence, as such pumps usually work against the atmospheric pressure, the net or effective pressure forms a small percentage of the total pressure, which, with the large extent of radiating surface exposed and the total absence of expansion, makes the expenditure of steam very large. One pump tested by the writer required 120 pounds weight of steam per indicated horse-power per hour, and it is believed that the cost will rarely fall below 60 pounds; and as only 50 per cent. of the indicated power is utilized, it may be safely stated that ordinary steam-pumps rarely require less than 120 pounds of steam per hour for each horse-power utilized in raising water, equivalent to a duty of only 15,000,000 foot-pounds per 100 pounds of coal on the same basis adopted for the vacuum-pumps. With larger steam-pumps, particularly when they are proportioned for the work to be done, the duty will be materially increased.

Ten thousand heat-units per pound of coal represent an ultimate efficiency of only (10,-000×100÷14,500=) 69 per cent. of the calorific value of anthracite coal, so that ordinarily more than (100−69=) 31 per cent. of the heat in the fuel is carried to waste up the chimney. A still greater loss is, however, experienced in utilizing the steam for the purpose of work in the engine. The mechanical equivalent of one heat-unit is 772 foot-pounds, which, on the basis referred to above, correspond to a duty of 772 millions of foot-pounds per 100 pounds of coal. The most economical steam-engines, for instance, pumping-engines of approved types, utilize in the steam-cylinder only about 130 millions, on the same basis, equivalent to an ultimate efficiency of (130×100÷772=) 16.84 per cent. of the heat in the steam, and but (16.84×.69 =) 11.62 per cent. of the calorific value of the fuel. The principal reason for this is that the exhaust steam necessarily carries to waste the heat required to maintain it in a vaporous state at the tension due to the back pressure. This, under the most favorable circumstances, forms the larger proportion of the total heat of the steam and reduces the opportunity for securing economy within small limits compared with the theoretical limit, although the differences between the performances of different engines are great when compared one with another.*

Means for securing economy in steam-engines may be divided into two classes, viz., those of a mechanical nature and those which influence the thermal conditions. As to the first, the necessity of securing tight pistons and valves, ample area of cylinder passages, reduced clearances, etc., are well understood, also the incidental advantages due to a certain degree of compression. Those of the second class act to reduce the cylinder condensation, and include high speeds of revolution, steam superheating, steam-jacketing, and the compounding of engines. High speed of revolution (which does not necessarily imply high piston speed, as generally understood) secures economy, by reducing the time in which the transfers of heat to and from the steam and inclosing walls must take place.

Superheating the steam has experimentally proved effective for moderate rates of expansion, in which the original temperature required to maintain the gaseous condition of the steam to the point of release was not too high to prevent proper lubrication.

* In view of discussions in progress at the date of writing on the proper details of a theoretically perfect steam-engine, it is proper to mention that in the year 1868 the writer designed and partially constructed a non-exhausting experimental engine in which the steam, after expansion in the cylinder, was to be circulated through another vessel, to withdraw the water due to the performance of work; the dry steam was then to be returned to the cylinder and compressed, which it was expected would require less power than the expansion would furnish, and sufficient steam only be received from the boiler to supply that condensed for work. A demonstration of the correctness of the principle only was intended, the power expected being so small that the experimental engine was to be connected to another to keep it in motion. Before the apparatus was completed the funds were diverted to objects of greater immediate necessity, and the subject is mentioned only as indicating the general principle upon which a theoretically perfect steam-engine may be constructed. See description of the apparatus in article on the "Theoretical Steam-Engine," *Scientific American* Supplement, August 18, 1877. See also Prof. Thurston's calculations on a similar subject in *Journal of the Franklin Institute*, October, November and December, 1877.

Continued on page 3.

Composition of Fuel.

BY JOHN W. HILL, M. E.

Charcoal, coke, coal, wood and peat are the fuels principally in use. Charcoal is obtained by eliminating the volatile matter from wood or peat by distillation in a retort or by partial combustion in a heap. A larger yield of carbon is obtained by the distillation process. According to Peclet, charcoal consists of carbon 93 per cent., and non-combustible or ash 7 per cent.

Anthracite coal consists almost entirely of free carbon and non-combustible. From eight specimens of American Anthracite analyzed by Prof. Johnson the mean composition is:

Carbon	86.76	per cent.
Volatile matter	4.98	" "
Moisture	1.18	" "
Non-combustible	6.97	" "
Sulphur	.11	" "

Bituminous coal consists of free carbon, hydrogen, oxygen, nitrogen, sulphur and mineral compounds constituting the non-combustible matter. From twelve analyses of free burning bituminous coal Prof. Johnson obtains the following means:

Cumberland Coals—

Carbon	73.72	per cent.
Volatile matter	14.20	" "
Sulphur	.12	" "
Moisture	1.56	" "
Non-combustible	10.40	" "

Pennsylvania coals—

Carbon	72.00	per cent.
Volatile matter	16.01	" "
Sulphur	.72	" "
Moisture	1.14	" "
Non-combustible	10.13	" "

Prof. Johnson's analyses of eleven varieties of Virginia caking bituminous coals furnishes as a mean—

Carbon	58.01	per cent.
Volatile matter	29.23	" "
Sulphur	.90	" "
Moisture	1.36	" "
Non-combustible	10 50	" "

Pittsburgh coal, known in the market as Youghiogheny, consists of—

Carbon	54.93	per cent.
Volatile matter	36.60	" "
Moisture	1.40	" "
Non-combustible	7.07	" "

Newcastle (England) coal has the following composition—

Carbon	56.99	per cent.
Volatile matter	35.59	" "
Sulphur	.23	" "
Moisture	1.79	" "
Non-combustible	5.40	" "

Of fifty analyses of Indiana coals the following is a mean—

Carbon	51.20	per cent.
Volatile matter	42.79	" "
Non-combustible	6.01	" "

The following composition of Ohio coals is obtained from the "Geology of Ohio," volume II, being a mean of fifty-seven analyses, chiefly by Prof. Wormley—

Carbon	56.62	per cent.
Volatile matter	35.03	" "
Moisture	3.19	" "
Non-combustible	5.16	" "

Coke is the product of coal after eliminating the volatile matter. The process is conducted either in retorts, as gas coke, or in coke ovens. The latter is preferable for furnace fuel. Coke contains, as a mean—

Carbon	85.00	per cent.
Non-combustible	15.00	" "

Wood contains about—

Carbon	50.00	per cent.
Oxygen	42.00	" "
Hydrogen	5.25	" "
Non-combustible	2.75	" "

The oxygen and hydrogen exist in proportions to form water, and the carbon alone is useful in giving out heat. For equal weights the calorific power of all woods used for fuel is the same. Exception should be made of woods of the same family, as the fir and pine, as these contain a small quantity of turpentine, which is a hydro-carbon.

Peat, or vegetable fuel, consists of—

Carbon	58.00	per cent.
Hydrogen	6.00	" "
Oxygen	31.00	" "
Non-combustible	5.00	" "

Lignite, although not generally classed as a separate fuel, occupies a position between peat and fully developed bituminous coal. Its composition is, as a mean—

Carbon	39.00	per cent.
Oxygen	10.00	" "
Hydrogen	2.50	" "
Non-combustible—nearly	50.00	" "

The fact is established by geological investigation, that anthracite and bituminous coals and lignite are of vegetable origin. Thus, wood consists chiefly of carbon, hydrogen and oxygen. By a process of natural evolution the wood suffers a loss of each of these elements, but principally hydrogen and oxygen, when we have as a result lignite. This suffers a further loss of nearly all its oxygen, more than half its hydrogen and a large percentage of carbon, when bituminous coal is the result. This suffers a further loss of a small percentage of carbon, and nearly all its hydrogen and oxygen and anthracite coal is the result. This, finally, suffers a loss of all its oxygen, nearly all its hydrogen, and nearly pure carbon or graphite is the result.

The following table of composition of combustibles is from analyses by Peclet and others:

Elements.	Coal.	Coke.	Wood. Perfectly Dry.	Wood. Ordinary State.	Peat. Charcoal.	Peat. Perfectly Dry.	Peat. Ordinary State.
Carbon	.812	.850	.510	.408	.930	.580	.464
Hydrogen	.048	..	.058	.042	..	.060	.049
Oxygen	.084	..	.417	.334	..	.310	.248
Nit'gen & Sulphur	.031	..	..	..	..	..	..
Water	..	..	..	.200	..	..	.200
Ashes	.055	.150	.020	.016	.070	.050	.040
Total.	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Elements.	Oil of Turpentine.	Alcohol.	Olive Oil.	Sulphuric Ether	Tallow.	Beeswax.
Carbon.	.884	.5196	.7721	.6531	.790	.816
Hydrogen.	.116	.1370	.1336	.1333	.117	.139
Oxygen.	..	.3432	.0943	.2136	.093	.045
Nitrogen & Sulphur.	..	..	..	..	..	..
Water.	..	..	.	..	..	..
Ashes.	..	..	..	..	..	..
Total.	1,000	1,000	1,000	1,000	1,000	1,000

Reynold's Patent Moulding Machines.

Herewith are shown cuts of Reynold's Patent Moulding Machines for metal castings. They have been building machines for pressing sand-moulds for over eight years, and have been continually improving them until they now have one which they consider perfect. In this machine the top plate is brought into place and locked there, the mould pressed plate unlocked and returned to its position by simply pulling on the lever, thus doing away with operations necessary in former machines, and simplifying and increasing the capacity of this one. These machines are built in the best manner, all working parts being protected from sand and dirt, and being perfectly simple and strong, and cannot get out of order by any fair usage. Several hundred of their machines of the various styles are now in use, some foundries running from fifty to one hundred each, and producing from 35 to 50 per cent. more moulds per man with less loss in pouring than they formerly did by hand ramming.

The prejudice and strong opposition of moulders and foremen has in some cases made the machine appear a failure, but in every case where the foremen and men have been in favor of the machine, it has done all that is claimed for it. The opposition in some shops has been very strong; but whenever it has had a fair show, and the foreman has given it a fair trial, the machine has been its own best recommendation, as is shown by the large number some concerns ave bought and are running.

The manufacturers call attention to the following advantages which their machines have over other moulding machines:

It occupies only 24x30 inches floor space.

It weighs only 350 pounds, thus saving freight charges.

It is perfectly simple and will not get outof order.

All wearing parts are carefully protected from sand and dirt.

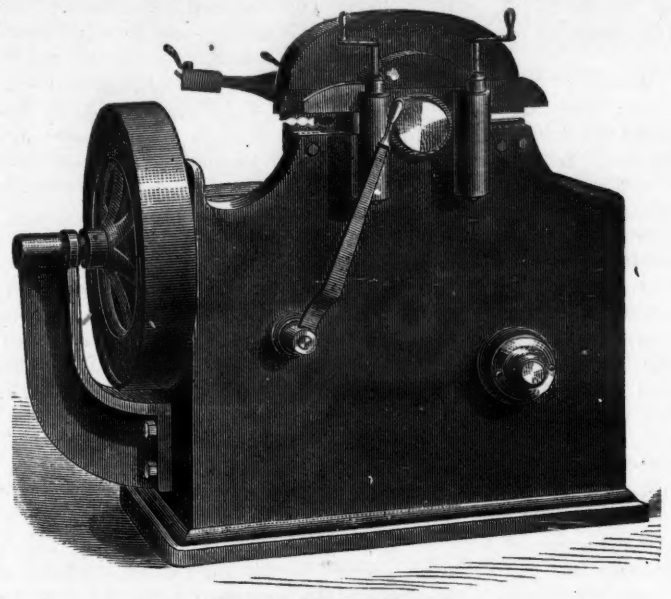
The top plate being swung from lever, and weight counterbalanced by steel springs, it requires very little labor to work it.

The top plate being loose, adapts itself to unevenness in sand, and does not spring thepatterns.

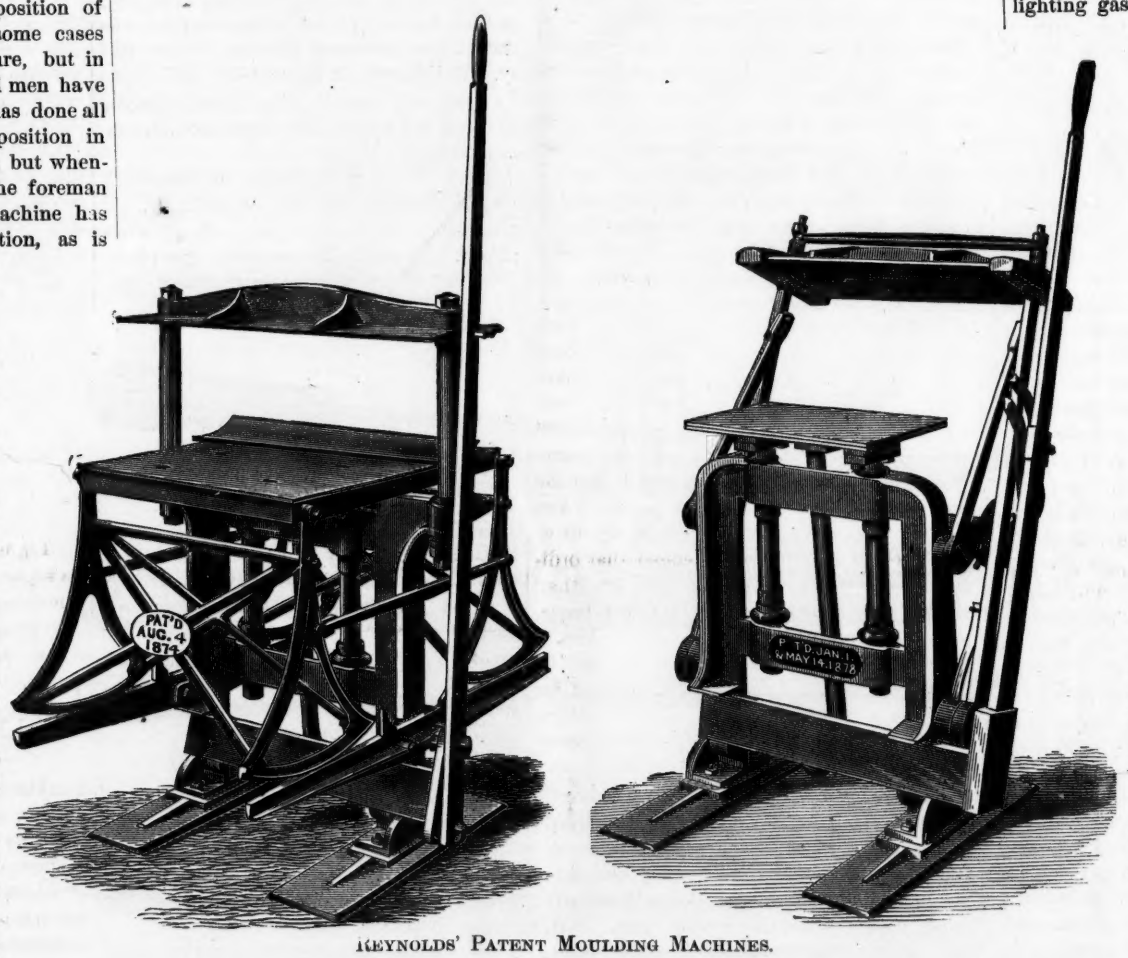
It requires no special flasks. An ordinaryflask with follow-board small enough to enter flask being all that is necessary.

The low price at which ti is sold, bringing it within reach of all foundrymen, and rendering it a paying investment.

For prices and further information address the manufacturers, Reynolds & Co., New Haven, Conn.



PRATT'S POWER SHEARS.



REYNOLDS' PATENT MOULDING MACHINES.

Pratt's Patent Power Shears.

This machine, which we herewith illustrate, is novel in its style and action, compact, and very effective. It is noiseless in its operation, and all its parts liable to be clogged by dust or injured by scale are contained inside of the pedestal, but are still fully accessible through the medium of doors. On a shaft passing through the machine from end to end is a worm engaging with a large worm-wheel. This shaft is driven by a faced balance-wheel (used as a pulley for belt), from which connection with the shaft is made by means of Pratt's Patent Friction Clutch. The transverse shaft carries the worm-wheel, which has an eccentric, forming a part of the wheel, a connecting-rod from which engages with the lower end or prolongation of a vertically vibrating horizontal cutter-head, furnished with steel jaws on either side the central bearing, which engage as shears with corresponding fixed jaws. One pair of these jaws is made with recesses of the form of segments of circles to receive round bars, and the other is straight. In front of the jaws are adjustable sliding rests, to resist the upward tendency of the piece to be cut, and at the back is an adjustable gauge for determining its length. The machine is started or stopped without the slightest shock, and there is no loss of power by starting it from a perfect stand-still. The starting and stopping is instantaneous. Speed of pulley or machine is 280 to 300 per minute. The steel cutting-blades may be removed from the jaws for sharpening or replacement, with very little trouble. The combination of screw, worm-wheel, eccentric, and lever, results in a machine of immense power. One size machine, No. 2, has been made. It will cut round iron to 2 inches diameter; flat iron $\frac{7}{8}$ inch thick to 3 inches wide. Weight, with countershaft, 4,600 pounds. They are manufactured by The Pratt & Whitney Co., Hartford, Connecticut.

American Electric Gas-Lighting Burner.

LIGHTING GAS BY ELECTRICITY.

Perhaps there is no more striking illustration of the tendency to improvement in our domestic ecionomy than is to be found in modern means of illuminating our houses, and even in the simple "process of striking a light." One does not need to be by any means the "oldest inhabitant" to remember the time when our fires were kept always burning on our hearths, or rekindled only by the slow and vexatious use of tinder, flint, and steel; when the evening darkness was made dimly visible by the tallow candle or the whale-oil lamps; and the wax taper only illumined the homes of the wealthy. By contrast with this it would seem as if the climax of convenience were reached when, in even our country villages, the odorless parlor match, and the ever ready gas jet, almost instantaneously turn darkness into day. But even this does not content us, it seems; there is yet an instant of time to be saved, and the very lightning itself must needs be pressed into service. And that it performs this service in the most perfect and satisfactory way, no one will fail to be convinced who will examine the latest appliance for the purpose, as furnished by the American Electric Gas Lighting Company, which is herewith illustrated. We say the latest, for the mere lighting of illuminating gas by electricity is not a new thing. Many devices have been brought to public notice in which frictional electricity is employed; but these are unreliable, being seriously affected by dampness, which very frequently renders them wholly inoperative, at least when applied to individual burners, as, for domestic use, they must necessarily be. Nor is this the first or only arrangement in which a battery, the only reliable source of electricity, is employed. But all others have been subject to a most vexatious mischance, technically known as "short-circuiting the battery."

Each burner is fitted with a pair of metallic points, between which the spark passes; and that if these be left in contact, no other burner can be lighted. Besides, the battery then rapidly consumes its own elements, and requires speedy renewal. This, in the apparatus to which attention is called, is absolutely prevented by a most simple and ingenious device. When we add that this is done without the addition of a single working part, it will be seen that more cannot be said in praise of its simplicity; and the whole mechanism has proved itself to be as reliable as it is efficient.

Nor is this a mere luxury. Notwithstanding the convenience of matches, their use is not unattended with danger; and there are many branches of industry in which nothing would be so desirable as the ability to dispense with their use altogether, on account of the risk of fire. This desideratum is attained by the use of chemical electricity, and the expense of maintaining the battery being a mere trifle—less even than that of furnishing matches, where many burners are to be lighted—it would appear that nothing further can be asked.

Persons who have this new method of lighting gas introduced may withhold payment for the same until they are perfectly satisfied that the representations of the inventor are fully met.

For further particulars, address American Electric Gas Lighting Co., 182 Broadway, Room 5, New York City.

[CONTINUED FROM PAGE 2.]

Mr. George P. Dixwell, of Boston, Mass., has applied a thermometer to a steam-cylinder, by inspection of which it is possible to regulate the temperature so as to prevent injury to the metal surfaces. The great difficulty is, however, to secure a permanent and reliable superheating apparatus. Steam-jacketing has to a limited extent advantages of the same kind as superheating, and involves no serious difficulties in management. The jackets are most effective on long cylinders of small diameter. In experiments with United States revenue steamers, hereinafter mentioned, the economy of a steam-jacket on a comparatively short cylinder was found to be 11 to 12 per cent.

Compound engines, in addition to advantages of a mechanical nature, in better distributing the strains and rendering more uniform the rotative efforts, serve also to reduce cylinder condensation by the distribution of the differences of temperature between two cylinders. The radiation to and from the steam and its inclosing walls increases more rapidly than the difference in temperature, so that the aggregate loss, when the difference of temperature is divided between two cylinders, is less than when it all occurs in a single cylinder. Moreover, the heat imparted to the exhaust steam by the metal of the first cylinder is available for work in the second, and the low-pressure piston acts as a screen between the high temperature in the small cylinder and the low temperature in the condenser.

Extracts from Chordal's letters.

Messrs. Editors:—I notice in your August issue a cut of Reid's drill chuck. I never heard of it before, but it strikes me as being a good rig if it is only well made. I ordered one of them, and will post you if it turns out well, and if it don't also.

I have been through the mill with drill chucks, not as a tool for light work in a shop doing light work exclusively, but as a light tool to be placed in the hands of heavy workmen.

I think I have tried them all. I wonder how many different ones have been invented in the last fifteen years. Many of them we never hear of nowadays. It would appear that out of the many the good ones should have been sifted by this time, leaving us to-day with only good drill chucks, but I am inclined to believe that, after sifting, the wrong pile was retained. Most all are too delicate to stand ordinary machine shop usage. The workmanship is most always excellent. I consider the Beach drill chuck one of the finest pieces of workmanship I have ever seen. But there is something wrong with the whole lot, and I think that judgment in construction will do more to give us good chucks some day, than will the invention of a dozen new principles of grip.

If chuck makers would only gather in a few of their old chucks scattered around the country and notice their bad points, they certainly would be able to devise some plan of remedy for the apparent evils. I notice that some chucks which answer very well in lathes and other horizontal machines, give out at once when used in an upright machine. Some man is bound to let them fall out of the spindle, and one such fall will ruin most chucks, those with jaws projecting endwise especially. If the chuck had three jaws originally, it will be found to have but one or two when picked up. Of course nothing but a cable would keep a chuck from falling, but it seems to me that the fall should be considered an essential duty, and that this duty should be kept in view when the chuck is designed. It may not be impossible to scheme out a drill chuck which may be good and still stand a fall of a couple of feet.

Charlie and Fred owned a little shop, and worked in it too. One of them could always be found at the big lathe, which swung thirty six inches. They had no chuck and had no spare cash to buy one with, so they concluded to build one. They got up a nondescript affair which was neither independent nor universal It had four jaws. A right and left screw ran across the plate and moved two jaws uniformly. This screw was necked, or turned down very small at the center of the chuck. A similar screw crossed this one at right angles and moved the other two jaws. This second screw was set far enough back to allow the aforesaid necks to clear each other. It will be seen that this was not such a bad sort of a chuck after all.

The boys worked on it for a wonderful length of time, but finally finished it, and made an excellent job of it too. When done they got the heavy thing blocked up on the lathe, and started it on the nose of the lathe spindle. Then they did what other reckless lathesmen often do. They put a block under one projecting jaw, and started the lathe. They soon forgot the details of the operation for they had unwittingly left the lathe center in, and, as the chuck screwed on the beforementioned center collided with the screws at their point of intersection. It quickly broke them both, and tore the screw caps loose in addition. With pale faces they stopped the lathe and unscrewed the chuck from the spindle, but as it came off it slipped from their trembling hands, fell on a crossgirt in the lathe bed, and broke into four pieces. It was a total wreck.

The cynic only knows no heroes. The dullest routine practice finds unknown somebodies who by bold originality have entitled themselves to that highest expression of praise "better than I."

This constitutes fame. We who live in shops have our heroes too. Men who have done what we would die without having done. Men whom we can respect without envy.

Henry Maudsley inventing machinists tools, to wit: the slide rest. Whitworth demonstrating the compatibility of accuracy and ponderosity. Sellers evoluting planing machines whose tool-finished surfaces are straight, straighter than most work "retouched" by skillful scrapers; Pratt and Whitney giving us cutters for gear teeth, formed not through the medium of erratic draughtsmen and more erratic filers, but by immutable linkwork, converting correct principle into correct result. The ancient Niles works imagining an up-ended lathe, and thus evolving the modern boring mill. Darling, Brown and Sharpe placing in the hands of every American machinist living, tools which incites his ambition and provides him with means for fine accomplishment. Corliss and Allen showing us the girder-bed engine with its direct metal between cylinder and main bearing. Some unknown man, who ought to be canonized, bringing us the twist drill. These are the men whose garments touch us daily. They are the heroes and examples of the shop..

But greater than all of these, to me, was a certain quiet dignified gentleman called DeLow. He was not the hero of an art, but was the hero of an artisan. He was simply a machine shop foreman, and was for twenty years before he died. His rarity entitles his name to mention, for few foremen so well understood the requirements or capabilities for good of their position. He was in the "mechanical" sense of the term a tramp. His life was not interwoven with any one shop. One day he said to me: "I know of no more pitiable subject than a foreman out of position after long years of narrow service in one shop. Gold in the shop he staid by so long, but the most inelastic lead in a new position. Nobody wants him. His usefulness is over, and if middle aged he calls his life a failure."

DeLow's usefulness was of the cosmopolitan order and instantly available.

He always worked for just eighteen-hundred dollars a year, and would often refuse higher pay for positions as superintendent, manager, etc. He said: "I am a foreman machinist. My province is the machine shop, which I must *control*. I am responsible for the quality and cost of the work. Chapman with his little shop paid me $1800 when his own income as proprietor was less than $1200, but he showed his sense by employing me, odd as it may seem, for he never made five cents out of that shop before I went there. He offered me half interest in the concern freely, but I declined, for proprietorship is not my profession."

I once became acquainted with the owners of a shop. They had a splendid field, a good plant, but wretched shop management. They were not mechanics and depended on some leading workmen, having no executive ability whatever, for the running of the shop. They opened their hearts to me and I suggested DeLow to them. They studied the thing over, multiplied his 1800 by all the digits, and finally sent for him. He came and conquered. Quietly but certainly he revolutionized that concern, gave their work a reputation, increased their capacity two-fold without expense, made the thing *pay*.

But he only staid a year. He went to them and said he must be king in the shop. His position and prerogatives must be respected by both men and owners. They understood his motives and peculiarities and concurred, but, on several occasions, had walked around "the dignity of his great office," so with the best of feeling all round he went elsewhere. He went to Wykoff's and staid a month, went to Hunter's and didn't stay at all. He wanted more dignity than Hunter had to spare.

The peculiar fitness DeLow possessed for his profession, as he called it, would be hard to describe. All who employed him admired and respected him, and revere his memory today, for he was one of those men who, though our employees, make us feel that the world is better for their having lived in it. I have met machinists in twenty states who have worked for him, and all hold his memory in high regard, which is a rare thing to be said of a foreman who does his duty by his employers.

Many of these men say they are better workmen and manlier men after having worked for DeLow. I know that any man who worked a year for him is a more valuable and better paid machinist than before.

In the shop DeLow was firm and just, handled his men's self respect with the greatest and tenderest caution, if they had any. Building upon that quality he increased a man's usefulness. If the man lacked the quality of self-respect, he discharged him incontinently.

He gave man and apprentice the best work he could do, and paid him accordingly. If incompetent, he reduced the grade of work and pay. He kept a man in his proper place, leaving the choice of place to the man's capability.

He had a wealth of resources for emergencies, but I never heard of his putting finger to work, never saw him touch a file or a hammer, and never saw him idle. He was the quiet and dignified physician of the machine shop's ills.

I knew him to resurrect two concerns, dead even to mortification.

Speaking of foremen; I hold my foreman responsible for every thing which passes him. I refer to moral responsibility of course. If a job is too poorly done or too well done—both are faults equally—I blame him. He can not lay it to the workman, for it is his business to see that his work is properly done by his men.

He should work by inspection not by faith.

Some men don't think work can be too well done. There is as much work done too well as too poorly.

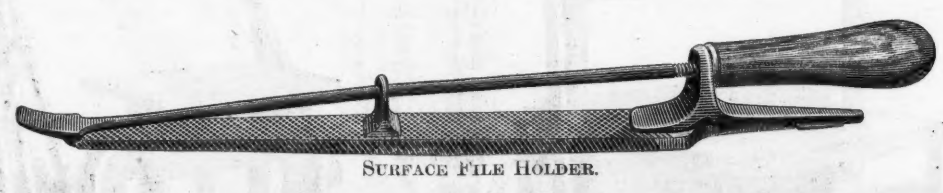
There is work which refinement is wasted upon. I put up about two hundred sorgum mills one season. The requirements were well understood by my customers, by my foreman and myself, in spite of which, one lot was fitted up with the nicety of a Corliss valve gear. It made the mills cost more and made them not a whit better. My foreman laid it to the men, said they would work on a job long after it was done. I told him he could not shift the responsibility to the men. I ordered a certain thing of him and it being in his power to furnish it, he should do it. If he would work fine men on such work he must stand the blame.

I have a queer pair in the shop now. A Philadelphia lathe and a Yankee lathe next to each other. Did you ever analyze the difference between these two types of machine construction?.

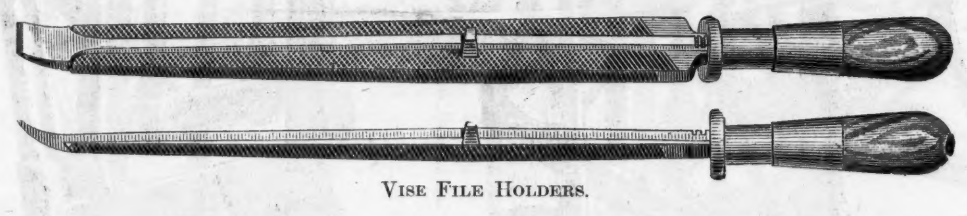
Its the same in engines, boots, locomotives, men, women, children, houses, and in fact every thing made in Philadelphia and Yankeeland. The merits of the two combined would produce the acme of material things. I would not trade my Yankee lathe for a Philadelphia lathe, and I would not trade the Philadelphia lathe for a Yankee one.

They are very far from being twins but both were born into the world for a wise and indispensable purpose. Some day I will give you the points of difference and, using the makers' names without invidious distinction, will try to show why and how two systems of design so far apart should obtain in sections so close together.

Very respectfully, CHORDAL.



SURFACE FILE HOLDER.



VISE FILE HOLDERS.

File Holders.

FROM A TREATISE ON FILES BY THE NICHOLSON FILE CO.

The object of the inventions herewith illustrated, is to provide a device in which files may be firmly held for service in surface filing, and while in this condition, *readily sprung*, in order to give, at the will of the operator, more or less convexity to the working face of the file.

By the use of this device, it is not essential that files, to be used upon broad surfaces, should be selected with the care usually bestowed to obtain a true convexity or "belly" to their sides; the trouble of such selection every master mechanic knows to be especially annoying and vexatious.

By its use, also, files may be more fully utilized, and made to render greater service than without it; 1st, By insuring full use of the side, which, were the file crooked, could not, otherwise, be obtained; and 2d, By being able, when the file becomes slightly dulled, by increasing its convexity, to lessen the number of teeth brought to bear upon the work, thus causing the lesser number of teeth which bear, to penetrate or "bite" the work, without increased labor bestowed by the operator.

The utility of the *Surface File Holder* will at once be apparent to the mechanic, in its application to broad cast iron surfaces.

The *Vise File Holder* will also be found a useful tool, particularly the smaller sizes, as, by its use, the file may be sprung to a degree enabling the workman to file in the exact spot required (always important where nicety of finish is requisite), in fact, utilizing the file in a manner never before accomplished.

These several file holders will be designated, and their range of sizes understood, by the following numbers:

VISE FILE HOLDER.

No. 1, adapted to hold files 5 and 6 in. long.
" 2, " " " 8 " 10 "
" 3, " " " 12 " 14 "

SURFACE FILE HOLDER.

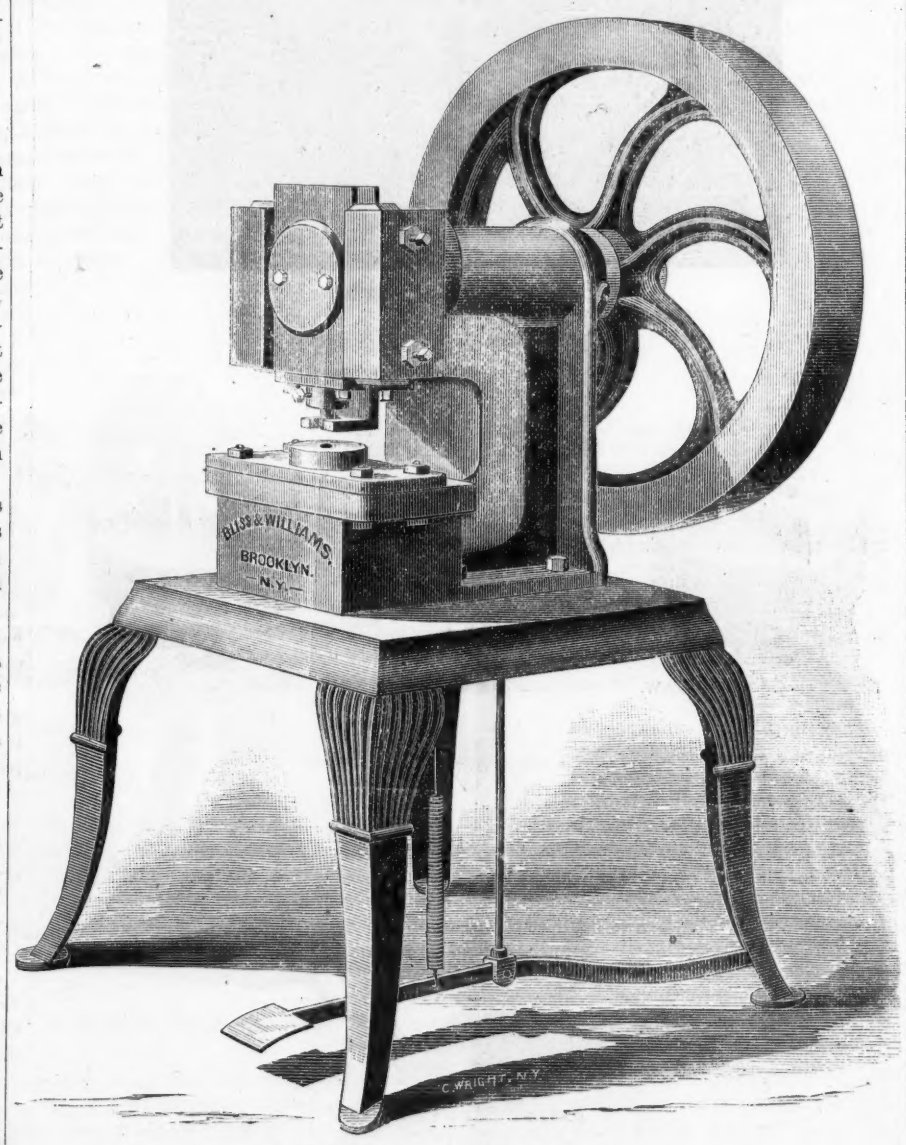
No. 4, adapted to hold files 12, 13 & 14 in. long
" 5, " " " 14, 15 " 16 "

Purchasing Second-Hand Boilers.

After about twenty years fair working—more or less according to the original quality of the iron and a variety of other circumstances—a structural or molecular change begins to take place in the plates of boilers, that is to say, they gradually begin to change from a wrought or fibrous to a granular or cast-iron, and when this change commences they can no longer be worked with safety. It is indeed true that boilers have worked well for thirty-five years; but they are like people with diseased hearts, they may live a long time, or they may die with terrible suddenness. If a boiler is found to crack in any portion of it that is not directly exposed to the action of the fire, it is a sign of danger, and the boiler should be replaced by a new one as soon as possible. Great caution should be observed in the purchase of a second-hand boiler; and it is never prudent to buy one, however well it may look, unless the age is known to certainty.—*Sexton's Boiler Makers' Assistant.*

New Power Punching Press.

The accompanying illustration represents a new power punching press designed and built by Bliss & Williams, Brooklyn, N. Y. It is calculated for reliable and accurate working, durability, and convenience of operation. It has no more parts than are actually required and being well made is not liable to get out of order. The weight of the machine complete is about 2,000 pounds, and it will punch ¾ inch holes in ½ inch iron, or ⅝ inch holes through ⅝ inch iron. The opening in the bed is 4 inches diameter, distance from back to center of slide 6 inches, and from bed to bottom of slide when slide is up 7 inches. The motion of slide is one inch, and the adjustment of the same 1¼ inches. The balance wheel is 37 inches diameter, 5 inches in width, and weighs 600 pounds. It is intended to make 100 revolutions per minute. All the parts are well proportioned. The firm of Bliss and Williams have had many years' experience in manufacturing presses and dies, their customers being found in almost all parts of the world.



NEW POWER PUNCHING PRESS.

Piston Speed of Engines.

Messrs. Editors :—Piston speed in the steam engine is the number of feet traveled by the piston per minute, and hence is the product of twice the stroke by the number of revolutions. Thus an engine of 24 inches stroke at 100 revolutions shows $2 \times 2' \times 100 = 400$ ft. piston speed (p. s.) It is a vaguely understood but very important factor in correct engine performance. It directly affects the power, economy, regulation, smooth running and durability of the engine, and we will briefly outline its relations to these in turn.

The power of an engine—other things being equal—is in direct proportion to its piston speed, hence we may develop a given power as readily by a small engine at a high speed, as by a large engine running slow. To illustrate:—a 12×24 at 125 rev., or 500 ft. p. s., will develop the same power as a 15×30 at 64 rev., or 322 ft. p. s.; and these proportions are a fair illustration of ancient and modern practice. In the well known formula for horse power:—

$$\text{H. P} = \frac{A \times P \times 2S \times N}{33000}, \quad 2S \times N$$

is the piston speed and the power varies directly as that factor. It is simply one expression for the familiar dynamic law of leverage, and its principles are too generally understood to call for further discussion.

The important relation of piston speed to economy of fuel, on the contrary, is but little recognized outside of professional engineers. The first and most obvious advantage is, that in developing a given horse power by increasing our speed, the amount of work done *per stroke* is proportionately lessened; hence, we may cut off the steam at an earlier point of the stroke, and gain the well-established benefits of expansion. And we may continue to so increase our economy by increasing our speed until the point of cut-off falls back in general to about 1-5th of the stroke. At earlier points of cut-off other causes begin to operate to vitiate the economy and we begin to lose very rapidly, until with very early cuts the waste of steam becomes far more extravagant than with even the primitive forms of engine with steam following full stroke. The discussion of this phenomenon does not belong here. We know many such engines now running, and the only remedy in such cases, short of a smaller engine, is to slow down the speed, and this is only partial in its effects as we shall see. We note, then, this exception to the general rule of advantage from high speeds.

But we go still further and say that of two engines of different size, doing the same work and so speeded that the load per stroke, and consequently the point of cut-off and grade of expansion are the same in each; instead of exhibiting the same economy, as the theory of expansion alone would indicate, and as is claimed by many builders, there is invariably a very marked difference in favor of the smaller engine at the higher speed. And yet further—two engines *of the same size*, but of different speeds—each with a load which shall compel the same point of cut-off and grade of expansion,—the engine having the highest speed will invariably show the highest economy per horse power developed. The item of high piston speed alone—everything else being equal—is good for at least 10 per cent., and often much more in economy. A full discussion of the reasons would be too extended, but briefly they are these. From the moment steam leaves the boiler it begins to condense. The amount of condensation depends upon 1st, the amount of condensing surface exposed; 2d, its thickness; 3d, its conductibility; 4th, the variation of temperatures; and 5th, *the time of exposure*. Piston speed evidently does not affect the second or third items. Now taking our examples, and illustrating the first supposition, each engine at the speed named, and with say 35 lbs. m. e. p. (mean effective pressure) will develop 60 horse power. The greatest loss from condensation occurs during admission, and immediately following cut-off, when a large surface, previously cooled by expansion and exhaust is to be reheated by a small volume of live steam. Supposing cut-off in both instances to be at 1-5th stroke, it is true more surface per horse power is exposed in the smaller engine, but from the rapidly repeated strokes, the *time* during which the cooling and reheating of the cylinder from each stroke can take place is so short that, in familiar phrase, *the cylinder does not have time to cool*, or the steam to condense, and the gain from this source very largely overbalances the detriment of increased relative surface. Being true in the case of large *versus* small cylinders, much more is it true under our second assumption of equal cylinders, at different speeds, and we are at once brought up to the further and final statement, that at a given piston speed, the greatest economy will result from a short stroke, minutely subdividing *time* by a high *rotative speed*. In brief, not only high piston speed, but high piston speed obtained by high rotative speed, is necessary to fine economy.

High piston speed is necessarily accompanied in practice by high rotative speed, and we are here so considering it; and hence it benefits regulation in this wise:

First—it obviously increases the efficiency of the fly-wheel. Second—the governor has control of the engine only during the admission of the steam, and not after cut-off. Hence, the faster the rotation the oftener the governor has a chance to act, and any sudden variation of load which, taking place during a protracted expansion, would seriously affect the speed, is here immediately corrected by the rapidly recurring periods of control.

The final question of smooth running is so evidently dependent upon adaptability of design and perfection of workmanship, that we must premise superiority in this respect. This assumed, a rapid running engine does not hang or strain on its centers, but trips them easily, and coupled with well adjusted compression the operation of a well-built engine is seldom impaired by an increase of speed, aside from the obvious advantage of a lighter load per stroke. The uninformed are very apt to charge a quick running engine with rapid wear. Such is by no means the case, always premising that it is after all a question of build. An important and actual gain in durability dependent entirely upon high speed must be noted. The most destructive action on the main bearings of an engine is due, not to the thrust of the piston, but to the dead weight of the fly-wheel and shaft—for the reason that its slight motion from side to side of the bearing conduces to free lubrication, while the dead weight on the bottom of the bearing, if excessive, squeezes out the oil, and the journal runs dry and cuts. Now the value of a fly-wheel increases as the square of its revolutions. Hence, a fly-wheel to control an engine developing a given horse-power at 100 revolutions need only be *one quarter* as heavy as is necessary for the same power at 50 revolutions. The surface speed of the shaft in its bearing is, however, doubled; so that combining the two factors we have a co-efficient of wear as 2 to 1 in favor of the quick runner. We must also consider the fact that high speed engines possess generally much larger shafts and longer bearings, which still further improves the case.

We have by no means taken up all the points involved in the question of piston speed, and our treatment of such as we have considered is necessarily very concise, not admitting of carrying out the proofs into figures. But we trust we have indicated the general foundation of the benefits of speed towards which modern practice is tending, and which benefits are now tangible and well established facts. It is unfortunate that a limit in this direction is imposed in most automatic engines by the necessity of some form of independent detaching cut-off valve gear, which admits of only a limited number of strokes per minute, regardless of the size or proportions of the engine.

The above discussion, it will be understood, relates in full only to the automatic engine, which alone is worth considering, since by it only can the demands of modern manufacture for economy and close regulation be even approximately met.

Resolving the whole matter into the grand *summum bonum*—dollars and cents—we find that the high speed engine deposits at once to the credit of its owner a handsome principal, viz:—saving in first cost and space occupied from the smaller size requisite to a given power—and upon this paying a handsome and perpetual interest in the reduction of coal consumption.

WM. LEE CHURCH, M. E.

Millers and Grinding.

MESSRS. EDITORS:—One very singular fact among millers is that, as a mass, they assert that a four feet flat upper rimmed mill-stone is the best for grinding wheat, &c., and demand proof to deny the assertion. The very best of wheat flour can be made without flat-stones. Usually, a party thinking a flour mill would be good investment for business, or to help in building up a locality on account of the convenience "to mill," a millwright states "the mill will cost about so much," and engages at so much per day (portable mills are not to be thought of) poking day after day over massive timbers to build a "*husk frame*" in which to put the stones (pay better) usually four feet in diameter. The miller says they are best, and, as a general thing, he is *unable* to tell or figure out the area, cubic contents or weight of the stones he knows so much about, but this miller, as a general thing, guides to a certain extent the capital others invest. The man that furnishes the engine, &c., for motive power, the millwright that superintends the construction, are interested to make as big a job as possible, and in many cases the mill is an elephant when ready for business, if not before, ornamented with a mortgage to finish it, and frequently the ornamental mortgage robs the builder of his whole property, because paying interest on the *ornament* and interest on working capital *out-grinds* the the miller's choice of grinding stones.

It is far cheaper to put up a well-made portable engine and mill, leaving out the millwright's valuable counsel and time-consuming skill. There are thousands of mechanics who can set up engines and portable mills, and with a few days' practice do as well as any miller, because they have inquiring minds and the use of tools and the energy to use both.

PORTABLE.

Marine Boilers.

Do not allow the bilge-water to wash against the bottom of the boiler. Do not open the smoke-box doors when the boiler is in a heated state. If you have a surface-condenser and a new boiler do not use all condensed water, but use your auxiliary feed until a thin scale forms inside the boiler; there are instances of new boilers having been ruined by injudiciously being kept "*too clean.*" When once the sediment or salt attaches itself to the boiler keep it as clean as possible afterwards; be careful not to allow pieces of cotton-waste to remain in the boiler. Do not blow the steam and hot water out, and then run the boiler up full of cold water.

The Planimeter.

BY STEPHEN ROPER, ENGINEER.

The Planimeter, though not a recent invention, is almost unknown among engineers on this continent. This arises from the fact that, after its invention by Amsler, certain Swiss and German engineers got control of it, and limited the number that should be manufactured to their own individual necessities. It has never been manufactured in this country, or even offered for sale, until quite recently. Its functions are to measure indicator diagrams, irregular flues, steam passages, and all difficult or intricate figures. It gives at once the area of a figure, without any second measurement being required, as the reading shown on the index counter gives the accurate area in square inches of the diagram over which it had been passed.

To use the instrument, fasten the figure to be measured on a smooth board, and insert the point A in the board at any convenient location; then make a mark on the diagram, as at D; next fix the movable point B at the place selected for starting; then turn the index roller G round until O on its periphery corresponds with the O on the fixed vernier; then move it around the figure to the right, or in the directions of the hands of a watch. After it passes around the entire figure, note how many whole numbers and sub-divisions have passed the O on the vernier. The whole number will indicate the square inches, and the sub-divisions tenths of square inches. If the O on the vernier falls between two sub-divisions marked on the roller, read the number of square inches and tenths, then look on the vernier from O to 10, and find a mark which coincides with one on the roller; the number of such mark, counting from O, will be the hundredths, or second decimal place.

Thus suppose, that in the figure measured, six sub-divisions, and part of another one have passed, and that the fourth mark on the vernier coincides with a mark on the roller, the area of the figure will be either 3.64, 13.64, or 23.64 square inches, according to whether the roller has made less than one, more than one, and less than two, or between two and three revolutions. The eye can readily decide as to the number of revolutions the roller has made, as it would be impossible to make a mistake of ten square inches in estimating the area of a figure within the capacity of the instrument. If the figure measured is an indicator diagram, it will nearly always be of less area than ten square inches; or at most, only a trifle more, as the utmost capacity of the indicator is 5¼ by 2¾ inches, or 15½ square inches, and it very seldom worked beyond 4 by 2½ inches.

To find the mean effective pressure of a diagram from its area.—Multiply the area by the scale, and divide the product by the length of the diagram in inches. Or divide the area by the length of the diagram, and multiply the quotient by the scale. The product is the mean effective pressure.

Example.—Suppose the area is found as above, to be 3.64 square inches, the scale 40 and the length of the diagram is 3¾ (3.875) inches.

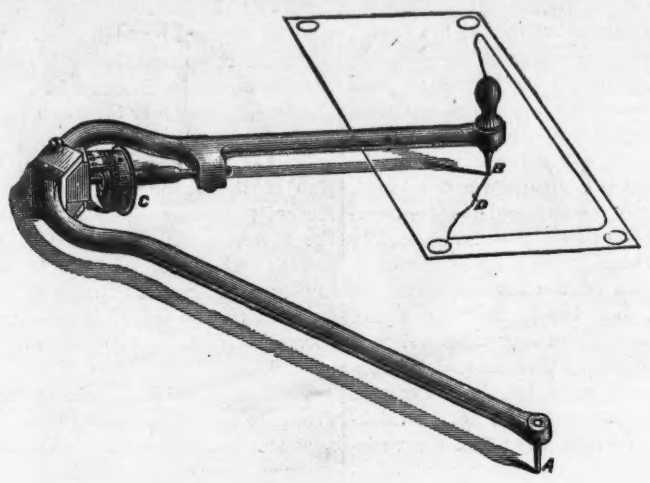
$$3.64 \times 40 \div 3.875 = 37.57 \text{ lbs.}$$

or $3.64 \div 3.875 \times 40 = 37.57$ lbs.

It will be seen that the labor of calculation will be facilitated, if, in taking the diagrams, care is taken to make them even inches in length. But as the engineer will have to measure many not of his own taking, he should have a rule divided into hundredths.

The annexed diagram was measured by the Planimeter, and gives the following results:—Area 1.34 square inches, 1.34 multiplied by 40, the scale, —÷1.98=27, the mean effective pressure.

The area of a figure may be taken without placing the O on the roller opposite the O on the vernier, but in such cases it is necessary to take the reading before and after the tracing is made; the difference between the two readings will be the area of the figure. But it is preferable to place the O's together. The movable point of the instrument may also be turned to the left, but in this case the reading must be subtracted from ten to give the true reading. Each of the figures stamped on the roller indicates a square inch of area, and if a figure contains ten square inches at the tracing point, the roller will revolve once, and the O's will coincide as at the start.



THE PLANIMETER.

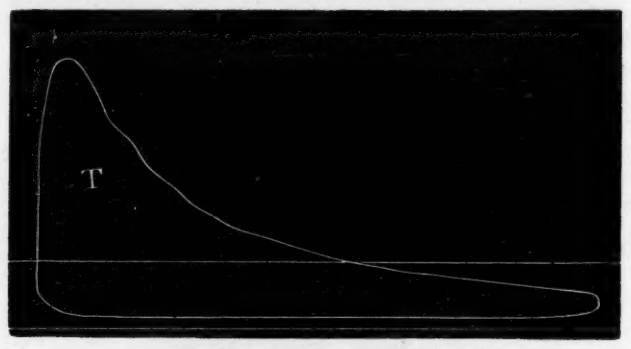
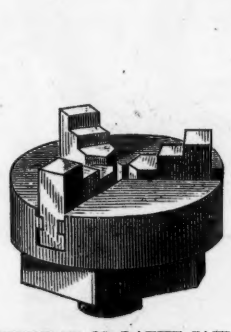
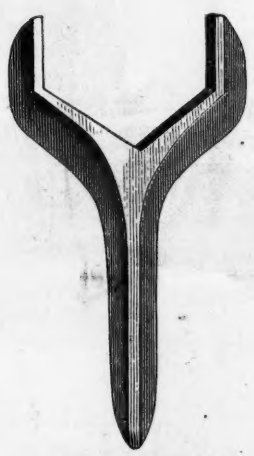


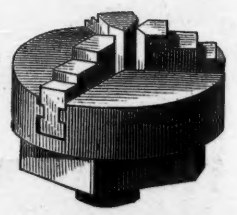
DIAGRAM OF PLANIMETER.



REGULAR OR LATHE JAW.

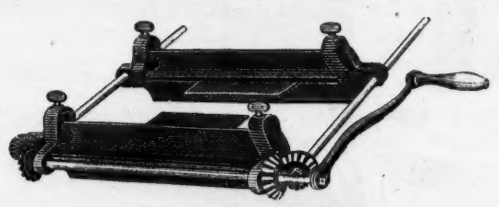


SPANNER WRENCH.

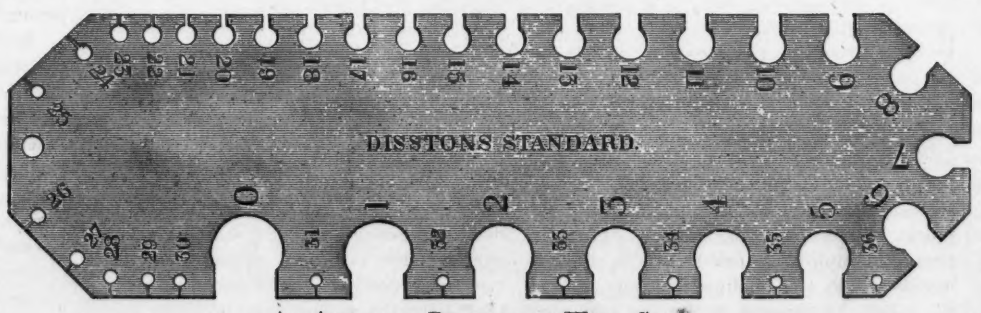


REVERSE JAW.

UNIVERSAL LEVER CHUCK.



PATENT BELT CLAMP.



AN ACCURATE BIRMINGHAM WIRE GAUGE.

Universal Lever Chuck.

The above cut represents a two inch Universal Lever Chuck. It has two different styles of jaws, one for holding articles by the outside or rim, and the other by the inside.

It is claimed to be the most comprehensive style of chuck yet offered to the public. Its jaws are moved backwards and forwards by means of a spanner wrench, which accompanies each chuck. Parties desiring two sets of jaws for the same chuck can obtain them by ordering.

For further particulars address Frasse & Co., 62 Chatham St., P. O. Box 4627, N. Y. City, who are the principal agents.

An Accurate Birmingham Wire Gauge.

The well known house of Henry Disston & Sons, having for many years experienced great difficulty in their business by reason of the inaccuracies of so-called standard gauges, their experience being that not one in ten could be relied upon for exactness, determined some months ago to enter upon the manufacture of gauges which their customers could rely upon as being all alike. They have, in this line, achieved as complete a success as with saws, files, and other tools, a fact which in time will be made manifest to the great body of mechanics. The standard gauge herewith illustrated, is warranted to be correct, and is sold at a lower price than the English. Great care is taken in their manufacture. After they are hardened the gauges are placed, one upon the other, tried with plugs, and the spaces made to conform. They are made to order when desired, in different series of high or low numbers, according to requirements of use. If the articles to be gauged range no higher than Nos. 10, 12, 15, or any particular low number, the purchaser need not go to the expense of a gauge running to 36, when most of the numbers will be of no use to him. When one or more numbers are being constantly used they wear away faster in proportion, in which event it is recommended that duplicate incisions of each of the most used numbers be made in each gauge. They also make a gauge of smaller size than the one shown in this cut, but of the same standard. In gauging plate, and sheet iron, and steel, it is of the utmost importance to have a gauge to the Birmingham Standard, that can *invariably* be relied upon, and this is what Henry Disston & Sons have produced.

Patent Belt Clamp,

FOR DRAWING BELTS TOGETHER FOR THE PURPOSE OF LACING THEM.

The accompanying cut represents one of the most complete and useful articles for those using belts of a width requiring to be drawn together and laced while upon the pulleys.

This apparatus has proved itself indispensable to every establishment using belts six inches wide and upwards, and will soon pay its cost in saving of time in lacing belts quicker and better than any other way, and avoids any necessity or excuse for injuring a wide belt by putting it upon the pulleys after it is sewed.

They are of Gardner & Miller's patent, and are made in the following sizes, viz.: 8, 12, 16, 20, 24, 28, 32 and 36 inches.

Further information can be obtained of C. E. Billings, Hartford, Conn., who has the exclusive manufacture and sale of the above named Patent Belt Clamp.

MOULDING SAND FOR CASTING BRASS OR IRON.—The various kinds of good moulding sand employed in foundries for casting iron or brass have been found to be almost uniform chemical composition, varying in grain or the aggregate form only. It contains between 93 and 96 parts silex, or grains of sand, and from 4 to 6 parts clay, and a little oxide of iron, in each 100 parts Moulding sand which contains lime, magnesia, manganese and other oxides of metal, is not applicable, particularly for the casting of iron or brass. Such sand is either too close, will not stand or retain its form, or it will cause the metal to boil through its closeness.

CASE-HARDENING FOR IRON.—Cast iron may be case-hardened by heating to a red heat, and then rolling it in a composition composed of equal parts of prussiate of potash, sal-ammoniac, and saltpetre, all pulverized and thoroughly mixed. This must be got to every part of the surface; then plunged, while yet hot, into a bath containing 2 ozs. prussiate of potash, and 4 ozs. sal-ammoniac to each gallon of cold water.

TO REMEDY SLIP OF DRIVING BELTS.—Dab on a little of the sticky oil which oozes away from the bearings of machinery.

Sharpener for Lawn Mowers.

Any invention which facilitates the use, or simplifies the operation of mechanism already in use, at once assumes its proper place of importance in the hands of practical men. To this class belongs the lawn mower sharpener, (represented in the small cut, to which iron legs belong—not represented in the cut). The owner of any number of lawn mowers, and the mechanic who makes a business of repairing the same, will at once recognize the practical advantages to be derived from the use of this machine. Briefly summarized these advantages are as follows :

First,—A perfect cutting edge.

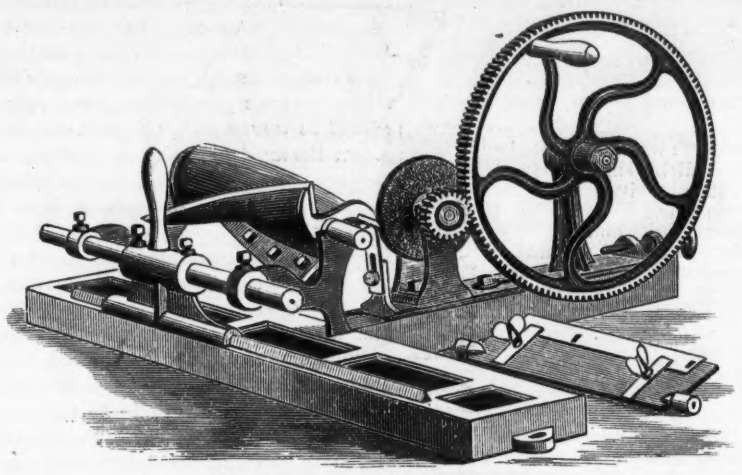
Second,—Accuracy in line and bevel is secured for both revolving and stationary knife, thus insuring perfect junction of the cutting edges at every point.

Third,—No dissection of the Cutter being necessary the previous adjustment remains unimpaired, and a very little readjustment suffices for putting the machine in running order after grinding.

Fourth,—Simplicity of construction and operation.

Fifth,—Saving time and expense,

The machine consists of a solid emery wheel upon a fixed shaft, and driven by hand or power ; an adjustable rest, upon which the knife edges play ; an adjustable device for holding the wiper and shaft entire while being ground, and an attachment for grinding the stationary knife.



SHARPENER FOR LAWN MOWER.

In operating the machine the revolving cutter is hung by the journals in the sliding iron frame provided. One of the spiral blades is then placed upon the steel rest, and the emery wheel brought to proper contact by a hand screw, which works the wheel stand ard forward and back. As the wheel revolves a lateral motion is given. The frame holding the cutter, and the friction of the wheel upon the knife holds the same upon the rest, while the whole cutter turns automatically in conformation with the spiral. The bevel given is determined by the height at which the rest is placed ; and, as the cutter shaft and emery wheel are always at the same relative distance, any inaccuracy in grinding is absolutely impossible ; *i. e.*, every part of the cutting edge is rendered equally distant from the center of the shaft The grinding of the stationary knife, when necessary, is accomplished in a similar manner, an attachment for the purpose being furnished with the machine.

There is no other machine for this purpose so far as we can learn. It is manufactured by E. J. Worcester, Worcester, Mass.

Combined Automatic Wire Straightening, Cutting and Milling Machine.

This machine is intended for making butt pins, bolt shanks, and similar articles. It has attachments for milling one end to a point or shoulder, and flattening, bending, squaring, or nicking the other end, as may be desired.

These attachments may be detached at the pleasure of the operator, and the machine used for ordinary wire cutting.

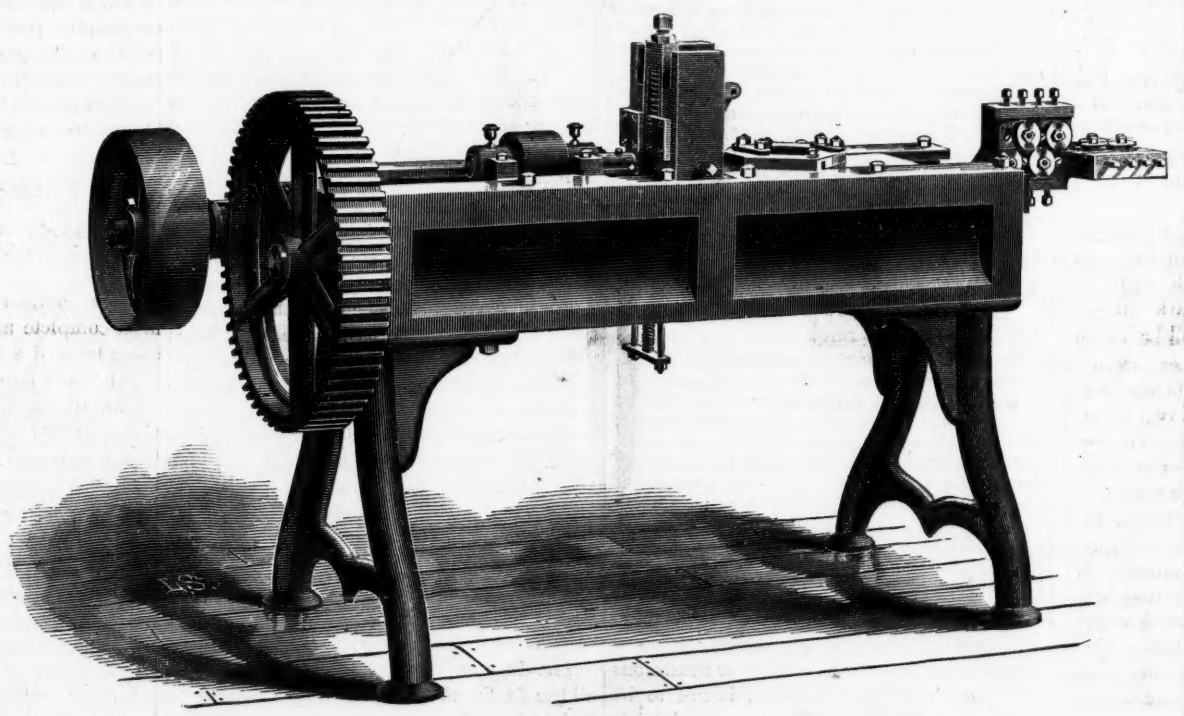
Several sizes of this style of machine are made, with or without attachments, as above.

They are manufactured by John Adt, New Haven, Conn.

The Use of Zinc in Steam Boilers.

The employment of zinc in steam boilers, like that of soda, has been adopted for two distinct objects, (1) to prevent corrosion, and (2) to prevent and remove incrustation. To attain the first object it has been used chiefly in marine boilers, and for the second chiefly in boilers fed with fresh water. We purpose dealing with each head separately in the above order, and in as popular a manner as the subject will allow.

The suggestion to use zinc for the protection of the copper sheathing of vessels by Sir H. Davy, and his development of this principle in 1824, appears to have suggested to Professor E. Davy about ten years later the application of zinc for the protection of the iron buoys in Kingston harbor. This is probably the first application of the principle to protect iron against the corrosive agency in sea water. The application of the same principle to protect the interior of steam boilers against corrosion does not appear to have been attempted before the year 1850. It was not, however, till the introducton of surface condensation for marine engines that zinc can be said to have been extensively used to prevent the corrosion of the iron plates and tubes, which were no longer protected, to the same extent by the scale that formed upon them when jet condensers were used.



COMBINED AUTOMATIC WIRE STRAIGHTENING, CUTTING AND MILLING MACHINE.

Zinc has been applied in various ways in marine boilers, viz., by suspending it in plates of various size and number from the trays, and more rarely amongst the tubes where practicable. The zinc plates or bars have been placed in boxes in various parts of the boiler, sometimes for the feed to pass through, and in other cases the zinc has been arranged for the feed to deliver upon it as it enters the boiler. As may be imagined, these various ways of applying the zinc led to very different results. In a great many cases its use was not attended with any apparent advantage, and it was consequently discontinued. In other cases, however, where its application had been made in a more judicious manner, it was more successful, and its use has been continued with very favorable results up to the present time.

It is evident, from the manner in which zinc has been employed in the great majority of cases to prevent corrosion, that the principle of its action has been assumed to be simply chemical; that it had a greater affinity than the iron for the oxygen and acids in the water. In order that this supposed simple chemical action should take place efficiently, and that the corrosive agents throughout the whole body of water should be neutralized, it would be necessary that they should all be brought in contact with the zinc before they would come in contact with the plates and tubes. Were the zinc soluble in water, this condition might be carried out, but as zinc is not soluble, and cannot reach all the corrosive ingredients in solution, or held in suspension and diffused throughout the water, it follows that all the particles of water must be brought and kept in contact with the zinc for a time in order that it may be really efficacious. That this is likely to take place in a large boiler with a few pieces of zinc cannot be maintained. Were the simple chemical action alone relied upon for the protective action of the zinc, the plates and tubes should be nearly covered with it in order that this action should be effective, since the iron would share with the zinc the corrosive action of the water in proportion to the surface of each metal exposed. We must then look for some other explanation of the success which has attended the introduction of a few bars of zinc into a large boiler.

The remarkable protection that zinc has afforded in many authenticated cases, can only be explained by ascribing it to galvanic action. When a metal like iron, which is acted upon more or less by a liquid, is brought into contact with another metal like zinc, which has a much stronger affinity for the oxygen of the liquid, or for the acids of the salts contained in solution, the zinc or positive electrode is dissolved and imparts a negative tendency to the iron, which preserves it by preventing the oxygen or acids from acting upon it. In most cases where zinc is employed with advantage to prevent corrosion in boilers, the water is a weak solution of salts. This solution is decomposed by the galvanic current in such a manner that the oxygen and acids are liberated at the positive pole (+zinc), and the hydrogen of the water and metal of the salt at the negative pole (—iron). The decomposition of the water, or electrolysis as it is called, takes place in such a manner that the oxygen of one molecule of water in contact with the zinc is separated, and the liberated hydrogen combines with the oxygen of a neighboring molecule, whose oxygen in its turn combines with the hydrogen of the next molecule, and so the action goes on till the hydrogen of the water in contact with the iron at a considerable distance is liberated, without the hydrogen and oxygen having to cross the water as free gases. It is in consequence of this action that a piece of zinc placed in the middle of a plate of iron has the valuable property of exercising a protective influence over a large surface of which it is the centre. The extent of the range of its action will depend upon the purity of the zinc, the nature of the salts in solution, the temperature of the water, and the condition of the surfaces of the zinc and iron. In order that the protective action may take place effectively, it is necessary that the zinc and iron shoutd be in perfect metallic contact. It is extremely probable that the fulfillment ornot of this last condition has determined the efficacy or non-efficacy of the application of zinc in the numerous cases where it has been tried with such different degres of success. Zinc "bottoms" should not be used, nor indeed is some of the spelter in the market sufficiently pure to act to the best advantage. But as a rule good commercial English or Belgian zinc may be considered as being sufficient for the purpose. A high temperature is favorable for the setting up of the galvanic current, and, therefore, for the protection afforded by the zinc. Besides having the zinc and iron in perfect metallic contact, it is necessary for the maintenance of the galvanic current, upon which the success of the application of the zinc depends, that the surface of the zinc exposed to the water should be kept clean and free from any non-conducting coating that may be formed by the chemical action that ensues on the liberation of the oxygen and acids at the surface of the zinc. This brings us to a very important consideration that is liable to be overlooked.

When the oxygen and acids are set free at the surface of the zinc, oxide of zinc is formed, and this combines with the acids to form salts. These salts are either soluble or insoluble in the water. If soluble they become diffused through the water, the zinc is kept clean, and the galvanic action is sustained at the expense of the zinc. If insoluble, the salts tend to collect upon the zinc, which in time becomes coated with them. As this coating is a non-conductor the galvanic action is gradually arrested, and in time ceases altogether, the presence of the zinc being consequently no longer efficacious.

With sea-water the sulphuric and hydrochloric acids, liberated from the contained sulphates and chlorides, combine with the oxide of zinc, and form sulphate and chloride of zinc, which are very soluble, hence the successful application of zinc in marine boilers. But in boilers fed with fresh water where the acids liberated are too small in quantity to combine with all the oxide of zinc to form soluble salts, the film of oxide that forms on the surface of the zinc in time puts an end to its useful effect.

It is well known that the galvanic current has no effect on the oxygen in solution in the water, and that it is only the oxygen chemically combined with the hydrogen in the water and in the bases of the salts that are liberated at the surface of the zinc. The question then arises, how can the zinc protect the iron from the oxygen in solution in the water which may be in contact with the plates? The answer is, by a secondary and chemical process, viz., the hydrogen liberated at the surface of the iron combines with the oxygen in solution and forms water, or the metals liberated from the salts at the surface of the iron unite with this free oxygen and form bases. In fact these metals have such an affinity for oxgen that they attract it from the water and residuary hydrogen is evolved.—*Engineering.*

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NEW YORK, SEPT. 16, 1878.

The Pawtucket Corliss Pumping Engine—A Practical Test and an Unexampled Performance.

Pumping engines to furnish a continuous supply of water are in use by most of our large cities and towns; their construction and adaptation calling for exercise of the highest engineering skill.

Heretofore the cost of first class engines in proportion to the actual work done has been too high for the resources of many towns recognizing the need of them, and the progress of our times has given rise to a demand for engines that may be relied upon to deliver more water with less original outlay and less cost of maintenance. The offers to meet this demand have been many; the general result disappointment. We chanced to hear a short time since of a new style of pumping engine in course of trial at Pawtucket, R. I., and, being in that vicinity, made a visit in time to witness the conditions of that trial. The engine referred to was designed and built by George H. Corliss, of Providence, the inventor and builder of the Corliss Steam Engine, and who furnished the grand engine that run the machinery at the Centennial Exhibition, who has given much study coupled with exhaustive experiments to produce pumping engines of higher practical duty than any others now in use. The trial showed a result considerably beyond the best heretofore on record, during a continuous run of 24 hours and a daily average, the practical working conditions being considered, never before equaled so far as we can learn, by any pumping engine in the world. To make the conditions of this test better understood by our readers we have procured a copy of the contract and specification under which this engine was built for the Pawtucket Water Works. It will be observed from the following extracts that the requirements are unprecedented.

(1).) The engine is to be capable of raising with ease three million (3,000,000) gallons of water in twenty-four (24) hours into a reservoir on Olney's Hill, two hundred and fifty (250) feet, more or less, above the water level in the pump well. It shall also be so constructed as to pump directly into the distribution during such time as the reservoir shall be under construction until its completion, and thereafter, when required. It shall be able to do this under the varying conditions then ordinarily obtaining, and with the pressure corresponding to the required head of 250 feet to the reservoir. It shall be able to do this with reasonable ease, smoothness and safety.

(5.) The engine when completed and ready for service shall be subjected to trial tests for duty and capacity; such trials to be made by the Chief Engineer of the Pawtucket Water Works and his assistants, on the part of the party of the first part, with the co-operation of, and in concert with, such parties as the party of the second part shall see fit to appoint. One of said tests shall continue for twenty-four hours incessantly, and shall be similar to the Lowell tests in June, 1876, with a similar provision in case of disagreement, as specified in Sections 7 and 11 of the "Specifications for a Pumping Engine," heretofore issued by said Water Commissioners. The other shall occupy two (2) weeks, omitting the intervening Sunday, running the fires ten (10) hours a day, as nearly as may be with the engine at such a speed as shall guarantee the delivery of 3,000,000 gallons in 24 hours. In this "every-day" running test, all the fuel shall be taken into account, the wood used for kindling being reckoned as equivalent to 45 per cent. of its weight in coal. No allowance to be made for ashes or clinkers. The coal used in these tests is to be first-class run of the mine, and the quantity of water delivered is to be ascertained by weir measurement.

(6.) The sum to be paid by the party of the first part to said party of the second part in full compensation for all work and supplies indicated in this contract, is $23,900; *provided* that it shall appear that the duty of said engine on the 24 hours' trial, heretofore provided for, is at least 100,000,000 foot pounds per one hundred pounds of coal when delivering 3,000,000 gallons of water in 24 hours against a head of 250 feet, and also that its duty on the two weeks "every-day running" test shall be at least 80,000,000 foot pounds per one hundred pounds of coal. In case, however, it shall appear that the duty of said engine is less on the every-day running test than hereinbefore stipulated, then said party of the second part shall submit to a forfeiture on the contract price of one and a half (1½) per cent. of said price for each one per cent. of said deficiency; and if said duty shall not exceed sixty millions (60,000,000) foot pounds, then said party of the second part agrees to allow said engine to remain for the use of said Town of Pawtucket, without charge, for a period not exceeding six months from the expiration of said tests, in order that time may thus be given for the substitution of another engine, after which it will remove it at its own cost, without claim for compensation in any way for the work it has done, or the expense it has been put to.

We know of no instance where a contract trial, *so exhaustive* and so *restricted to the conditions of every day work*, has ever before been demanded.

Its value, however, as showing what a pumping engine will do under the conditions of regular every-day practice, is not to be overestimated. As usually conducted trials last but a few hours, and the results taken under exceptionably favorable conditions, *with no proper allowance for fuel used to start the fire*, far outstretch what they will accomplish in average running.

The Pawtucket Corliss Pumping Engine embodies the important improvements which Mr. Corliss brought out in the Centennial Engine, and they are here applied to the service of supplying towns with an economical system of water works. It is arranged to work on the compound principle, the high pressure cylinder 15″ diameter, the low pressure cylinder 30″ diameter. Each have a stroke of 30″.

Three vertical tubular boilers were used, of the precise plan and dimensions of those furnished by him to run the Centennial Engine, the only difference being in the increased thickness of shell to adapt the boilers to the very high pressure contemplated. Two of them were used during the ten-hour daily running of the two weeks' trial at a pressure of 125 pounds, and the other for the night service during this trial, at a pressure of 100 lbs. No extra setting of elaborate brick work was employed. This arrangement became necessary as the reservoir was not completed as was contemplated when the contract was made, and the town was dependent on continuous pumping night and day.

The two weeks' trial began Tuesday, August 6th, at 8.30 A. M., and was completed Monday, August 19th, at 6 P. M., thus including two Sundays instead of one only, as specified in contract. The coal used was Schuylkill (Shamokin) of the quality used for the current supply of the works, and was taken from the pile *without being picked or selected in any way*. The first day at 7.20 A. M., the fires under the two boilers, which had been left without banking or replenishing since 6 P. M. the previous day, were drawn, the grates cleaned, and at 8.07 new fires were built, using 164 lbs. of wood and shavings, and 520 lbs. of coal to kindle the fire. At 8 30 A. M. the engine was started and the trial begun, the engine making an average of 51 revolutions a minute, steam at an average of 125 lbs., and delivering the water under head of 270 feet, including the estimated friction of the main, throughout the trial. A record was taken every ten minutes of the reading of gauges (water, steam, vacuum and receiver), the counter and the distance from the center of the water gauge to surface of water in pump well. Every stoking of coal was weighted and time noted. The engine stopped at half-past six in the evening. The fires under the boilers were allowed to smoulder until 7.30 next morning when they were hauled, new fires built, and the trial proceeded with, continuously in this way, from day to day. It was found on Monday morning that an extra amount of coal was required to get up steam after an interval of 38 hours' rest against 14 hours of other days.

The coal taken from under the boilers was again used (after being sifted), no allowance being made for waste. An average of 85 lbs. of wood and shavings and 268 lbs. of coal was used every morning to start the fire under each boiler. The method employed of keeping an exact record of every pound of fuel used, both during the time of trial and in firing to make ready for trial, serves as an *effectual check to overstocking the fires*, as is frequently done in contract trials, where the record begins with starting of the engine without allowance for coal piled upon the grate in making ready. It often occurs, in computing the results, in trials of this kind, that no account is made of the wood used to kindle the fire, an item which is usually from 3 to 6 per cent. of the whole fuel used. In trials where the coal had been picked by hand, the apparent duty has been considerably increased. As shown by an expert, in the trial of the celebrated Lynn engine, in 1874, this excess of duty (as determined by the refuse) was 10.8 per cent.

At this trial each of the parties were represented by three practical men who took the records and carefully watched every detail.

The duty for the 12 days' trial, reckoning all the fuel used (wood at 45 per cent. of its weight in coal) *was not less than* 104,000,000 *foot pounds per* 100 *pounds of coal.* The duty for 24 hours *was not less than* 120,000,000 *foot pounds per* 100 *pounds of coal.* The engine during these tests delivered at the rate of 3,060,000 *gallons in* 24 *hours.* The representatives of both parties agree upon these results, which we hope to give entire in our next issue. We hazard nothing in saying that *no such results have ever before been achieved in a practical test of a pumping engine.* In comparing the work done by this engine with the best performances hitherto exhibited by others, it must be borne in mind that the rigor of the conditions under which this trial was made was such as to *preclude any species of manipulation to enlarge upon the actual duty performed.* Experts who were present while the trial was in progress, and who examined the methods employed, unite in declaring it conducted with a degree of accuracy in every detail never before coming under their notice in testing a pumping engine. The most critical could find no feature to take exception to in any of the arrangements nor lack of scrupulousness in carrying them out. We had the pleasure of conversing with two of the experts here referred to, Mr. W. H. Odell, of Yonkers, and Mr. Thos. D. Stetson, of New York, (the former at one of the trials) who expressed the belief that the performance of this engine was *beyond precedent*, and that a trial of such duration and care in checking possible error had never before taken place. Our own observations agree with this. The Pawtucket Corliss Pumping Engine has been regularly working since the last day of January, and during the whole time there has been no failure of any part. Its operation is smooth and safe at very high speed, and no engineer has pointed out any liability to accident.

A number of special trials have been made in order to show what the engine will do under different conditions of water pressure from 69 to 117 lbs. These results will doubtless, in due time, be given to the public in detail. Efficient service has been performed by this engine in several cases of fire in the town. It has also been severely tried when accidents have occurred in the pipe mains where the pressure has been suddenly relieved, once by the blowing off of a 12-inch water guage.

The tests that have taken place prove, beyond doubt, that Mr. Corliss has produced a pumping engine capable of much greater average practical duty, and at cost to the purchaser below what has heretofore been paid for engines of high duty, and which is calculated to work as great a revolution in water works engineering as the introduction of the Corliss Engine, thirty years ago, wrought in the application of power for manufacturing purposes.

Autumn Industrial Exhibitions.

Annual industrial exhibitions in the leading commercial cities of our country have become well established in popular favor within the past few years, and are likely to secure stronger recognition as our manufacturing industries expand. At this writing, annual industrial exhibitions are in progress in New York City, Boston, Pittsburgh, Chicago, St. Louis and San Francisco, and others are soon to open in Cincinnati and Baltimore.

The primary object of these public exhibitions is to bring producer and consumer together, or rather to bring prospective purchasers to view the choice products of labor and skill without that pressure to buy, incidental to inspecting them in the ordinary marts of trade, and especially to give the public the best opportunity to compare the fabrications of different establishments. The other object is to practically educate mechanics and other artisans in the improvements of the day. When properly managed, these exhibitions accomplish a vast amount of good. A person may learn more about a particular industry, upon which he desires information, in an hour's visit to a good exhibition than in weeks or months of inquiry and research without unusual opportunities. That managers sometimes make mistakes is not a cause for wonder; but there are certain radical mistakes the managers of long-established exhibition societies often make that ought not to be passed over in silence. The first of these is apportioning too much space to the display of articles familiar to almost every one, and which do not present a single new feature. Rolls of dry goods, common toilet articles, plain groceries and other every-day goods and chattels that have nothing novel or specially instructive to recommend them, are often given the greater space to the exclusion of mechanical objects that have peculiarly valuable attractions. Few people care to pay an admission fee to see what can conveniently be studied in shop windows along the principal streets of any city. The leading attraction, and the most instructive part of industrial exhibitions is *machinery in motion.* This fact is well understood by managers, and is made prominent in their posters and advertisements; sometimes more prominent there than in the exhibition itself. There are few visitors to any fair, either male or female, that would not be deeply interested by the operation of ingenious machinery. The machinery department should be, if practicable, entirely separate from the other exhibits, and if it occupies the greater part of the whole floor space more valuable will be the exhibition. Sometimes managers are not thoroughly practical, and are swayed by outside (or inside) influences brought to bear upon them. The public have a right to be

critical, and to fully express their views to the end that needed reforms may be made.

The Charitable Mechanic Fair in Boston, now in progress, was expected to present a large department of machinery in motion, as numerous applications for space were made by leading machinery manufacturers, but the result is a sore disappointment, as but little space was allowed them, while other articles, of far less importance as exhibits, occupy the body of the floor space. This is a deplorable mistake. A meeting was called in Boston of a number of machinery manufacturers and others disappointed in securing space for their goods, and it was decided to organize a new and independent exhibition society, and raise a guarantee fund to erect, at once, a building of sufficient capacity to make a good display of machinery in motion, tools and mechanical objects worthy of a mechanics' fair. The enterprise has met with hearty approval, and a good support is promised. It was intended to have the building ready and the exhibition open in the earlier part of October.

Machinery was in readiness to make an attractive and instructive display, but the time for organization was too short to admit of a satisfactory issue, and it has been decided to organize a permanent association and defer the exhibition until next September.

One mistake, sometimes made, is to license a number of catchpenny devices to wheedle visitors out of their small change. This is a nuisance and the managers well know it. The usual fee of half a dollar for admission to industrial exhibitions is too high for mechanics and the great body of people who are expected to attend, and should be reduced to half that amount. At twenty-five cents each, twice the number might be induced to attend, and perhaps more. The admission fee has been kept up to the same figure it was in flush times when mechanics received double the wages they do now. Many people have but an hour at a time to visit an exhibition, and cannot afford to pay repeatedly a high entrance fee. Needed reforms should be agitated until accomplished.

The One-Idea Mechanic.

Men of one idea are generally harmless, and are useful mainly to furnish amusement. The one-idea mechanic is a conspicuous individual. He has invented a rotary rat trap, a fuel-saving appliance for a boiler, or some other wonderful contrivance, and never tires declaiming its surpassing merits. Substantial appreciation is not likely to fall to his lot. He comes to regard his invention as one of the greatest and most valuable of the age, and is chagrined to find that it is but lightly esteemed in mechanical circles. After fruitless efforts to convice others that he alone is right, and they all wrong, he asserts himself vehemently, and hurls anathemas at the stupidity and prejudice of the whole class of master mechanics. It is in vain to attempt to show him that his invention is impracticable, that the same thing has been tried years before he conceived of it, and every time resulted in failure. He proudly points to his patent as convincing proof that you are mistaken, for if he were not the original and only inventor how could he obtain a patent? You answer that under our boasted system of encouraging invention, the same old thing is patented over and over again, perhaps, under various names and imaginative applications, but still devoid of any new feature. The one-idea mechanic is usually a bore of the most persistent and troublesome kind. He never flags in explaining the wonders of his pet contrivance, and the peculiar trials in introducing it. It may not be worth a fig, but the more he dilates upon it the deeper he convinces himself that he is a genius and the rest of the world old fogies. Flatter him and you add fuel to the flames, laugh at him and you incite to a stronger determination to "do or die," and perhaps hasten the inevitable failure. The best thing that can happen the one-idea mechanic is to have his idol shattered before it performs that operation upon him. Induce him to look outward—not always inward—and a reform may be accomplished. It is dangerous to let the mind dwell intently on a single object for any great length of time, as it tends to monomania, a very difficult disorder for physicians to heal. Many a mechanic has impaired his intellect by too intense study upon a single machine. The road to success through mechanical invention is strewn with wrecks, mental as well as financial, mainly because so many anxious plodders in the old beaten track never acquire more than the one idea they had to start with, and often this is positively erroneous. It is well to persevere in a worthy effort, but unwise to run in an old rut without inclination to get out of it. We have met one-idea mechanics who would earnestly insist that their invention or discovery completely upset the elementary principles of mechanism as laid down in the books. When any astonishing claims of this kind are presented it is well to investigate them carefully before jumping to a conclusion.

Lubricating Oil Humbugs.

Our contemporary the *Chicago Journal of Commerce*, some weeks since, published an article entitled "Frauds in the Oil Trade," in which the efforts commonly made to palm off upon too confiding consumers inferior mixtures as lubricants of the very highest order are justly denounced. It says:

There are people engaged in both commerce and manufacture throughout the West who subscribe to no commercial journals or other papers published in any of the larger cities, and, as a result of not having at hand any means of obtaining the prices of even staple articles, they are the helpless prey of trade pirates, who may be found on almost every rail road and stage line in search of small dealers and manufacturers, upon whom they may unload their spurious goods at exorbitant prices. As an instance, there are dealers operating at small jobbing points, and, for aught we know, in this city, who are and have, perhaps for years, been practicing the grossest deception in the single article of oils, the illegitimate profits on which would supply the whole business community with the means of protection, as well as much other useful knowledge, for a whole decade. The usual means employed to mask their frauds is to label packages with a euphoneous sounding title or trade mark, pretending to be a compound possessing all the lubricating qualities of the whole catagory of fine oils. These are dealt out in lots of from one barrel and upwards, at from 60c. to $2.00 per gallon. * * * *

From the varieties which can possibly compose the best lubricating oils, none but the best pure Sperm Whale, Neatsfoot, and Lard Oil possess anything like the value at which these spurious compounds are sold, which, in fact, are without exception composed almost wholly of oils, at a fair market valuation of from 25 to 30c per gallon, with only sufficient of higher priced oils to ease the friction upon the venders' conscience.

The artifices adopted by unscrupulous oil merchants to sell cheap mixtures for superior lubricating oils are many and ingenious. It is the opinion of some honest oil dealers that there are more sharks in their trade than in any other. This view is probably a distorted one, but unfortunately it has a broad foundation. If manufacturers are content to pay a high price for mixed oils sold under "euphoneous sounding titles," and extravagant claims rather than to buy the best well-known lubricating oils at lower prices, the loss must be set down to their lack of business sagacity.

The New York office of the "Berryman Feed Water Heater and Purifier" is now located at 97 Liberty St., under the management of H. T. Brewster.

The importance of superheated steam is practically illustrated at the Woolen Works of Messrs. Waterhouse Brothers, at Passaic, N. J. The "Carvalho" apparatus by hot water circulation under pressure, takes the place of a fifty horse-power boiler, which consumed 4,400 lbs. (two tons) of coal every twenty-four hours, and which did not produce sufficient heat in their drying-room. The "Carvalho" apparatus only consumes 400 lbs. of coal every twenty-four hours, and produces all the heat that is required. A clear saving of 4,000 lbs. per day. Engineers and others interested can see the apparatus in full operation at the above mills.

MANUFACTURES.

NEW YORK.

While a cast was being made at the Dutchess Iron Works, recently, at Poughkeepsie, the flask exploded and the molten iron was scattered in every direction, severely burning I. H. Collier, the proprietor.

The Buckeye Engine Co., New York, made a shipment to Germany last week, and among other orders, are filling one for the Mexican Mint, City of Mexico. They have recently increased their working force, and they have their hands full in keeping up with their flourishing trade.

The Hall M'f'g Co., 28 Dey street, New York, have just completed arrangements for future manufacture of their Prentiss' Patent Adjustable Screw and Swivel Bottom Vises by the old and well known firm of Bayley & Sewell, general machinists, Watertown, N.Y., whose high reputation is a sufficient guarantee of superior workmanship in that desirable implement.

Mr. E. A. Goddard, the general sales agent of the Goddard Solid Emery Wheel, manufactured at Essex, Conn., has just opened a warehouse in this city at 176 Fulton St., keeping in stock all the sizes and grades in general use. He is at present crowded with orders from old customers, who have become acquainted with the merits of the wheel during the ten years it has been before the public, although but limited efforts have been made to extend the trade. The points which have gained for it the reputation of a choice wheel may be stated as follows:

1st. It is a very free and rapid cutting wheel which makes it particularly adapted for grinding Cutters, Reamers and Fine Tools generally, where it is desired to preserve the temper.

2d. This wheel will not, under any ordinary circumstances, glaze or gum up.

3d. It is entirely free from any offensive smell.

4th. It can be run at a high rate of speed without danger of bursting.

For gumming saws, this wheel has had extraordinary success.

He gives full attention to putting up wheels within reasonable distance, and their prices are low compared to other good emery wheels.

RHODE ISLAND.

The American Enamel Co., of Providence, have all the work their capacity will accommodate, their business showing a substantial increase which is largely due to superior quality of their work, the greatest care being taken in every department of the works.

CONNECTICUT.

John Adt, New Haven, reports business good. He is now employing sixteen hands.

L. F. Standish & Co., New Haven, have recently commenced manufacturing Morton's Patent Needle Clamp, and are quite busy.

The Billings & Spencer Co., Hartford, are pushed with orders, and are now employing seventy hands.

MASSACHUSETTS.

Lyman Wheeler, Westfield, Mass., reports he has sold more of his engines during last month than ever before during same space of time.

The Washburn & Moen Manufacturing Company have begun preparations for the erection of another rolling mill at their Grove street works Worcester, Mass., which will make three at that location. The building is to be 166 feet long and 65 feet wide. Power will be furnished by a 600-horse power engine, to be built by the Corliss Steam Engine Company, of Providence, and the bars are to be heated for drawing in a Siemens gas furnace. The contract for the engine requires its completion November 1st, and the new mill will be pushed as fast as practicable.

The Fitchburg Steam Engine Co. have just fitted out a large coal shed for Fitchburg R. R., with boiler and engine, seven friction hoisting drums, 250 feet of shafting with hangers, 600 feet of wire rope, etc., making the most complete coal hoist in New England. They exhibit a boiler and several portable engines, governors, printing presses, etc., at the Charitable Mechanic Fair in Boston. During the late New England Fair at Worcester, one of their semi-portable engines ran a wire fence machine attracting a great deal of notice. They are sending a great many yacht engines West.

PENNSYLVANIA.

The American Iron Works of Jones & Loughlins, Pittsburg, are running double turns, or night and day. This gives employment to 2400 operatives.

The Dunbar Furnace, Dunbar, is now thoroughly equipped, they make 80 tons of iron a day. The chimney they have just built is 165 feet high, and saves them 25 bushels of coke per each ton of iron.

The *Bulletin* of the Iron and Steel Association says: "It is authoritatively stated by the proprietors of the Baldwin Locomotive Works that they will build in 1878 no less than 300 locomotives, against 185 in 1877. The firm now employs 1,250 men, its usual complement, and the number seems not likely soon to decrease."

OHIO.

The Cleveland Rolling Mill Company are about to enlarge their foundry and build a new pattern shop.

The Portsmouth Foundry and Machine Works cast a pump chamber for the Cincinnati water works, some days ago, which weighed 10,250 pounds.

George Naysmith, a machinist in Bolton, Meyers & Co.'s steel works, Canton, has invented a machine for polishing round iron from one-fourth to three-fourths of an inch in diameter. The invention is well spoken of.

VIRGINIA.

The machine shops of Wm. E. Tamers & Co., Richmond, Va., are in vigorous activity. The demand for their portable engines and boilers drives them nearly up to their capacity.

MISSOURI.

Messrs. Gray, Bowman & Co., of St. Louis, have disposed of the machinery department of their business to the Gray, Bowman Company.

ARIZONA.

The first iron foundry in Arizona, was recently put in blast. Castings heretofore have been brought from San Francisco.

Questions and Answers,

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. M., Wooster, Ohio, asks, Will you please give (through your paper) a receipt for making a smooth, durable mould of some sort of cement, for making fine castings, and oblige? A. J. M. does not state what kind of castings he desires to make. If he wishes to make brass castings, nothing better than fine molding sand has yet been discovered. Make your mold of fine Albany sand, and dry the face of the mold—if for fine castings, by holding a lighted rosin torch under the face of the mold. If for white metal, take one part plaster of Paris, one part finely pulverized brick dust and add a little alum to make it set hard, and dry it thoroughly before using.

(2) A. P., Newark, N. J., says, Please inform me through your valuable paper, what pressure I can carry with safety on a cast iron boiler, 10 inches diameter, 16 inches long, thickness of metal ⅜ inch. Will brass tubes do in place of iron, and how many will be required in order to make steam fast? A. The formula for strength of thick cylinders shows a safe pressure of about 75 lbs. per inch. But the great uncertainty of the grade and soundness of cast iron makes any formula very unreliable. Iron tubes are best, and the boiler, if horizontal, should be filled for half its diameter; if vertical, entirely filled. But we would say—*don't!*

(3) H. K B., St. Louis, Mo., asks, When did James Watt complete his first engine, and when, and to whom was given the first patent for a steam-boiler? A. James Watt completed and patented his first engine in the year 1768-69. Papin used a steam pressure boiler in 1695, and Savory patented a steam engine with a pressure boiler in 1698.

(4) R.V., Cleveland, Ohio, asks, How can I remove the scale from steel articles? A. By pickling in water with a little sulphuric acid in it, and when the scale is loosened, brushing with sand and a stiff brush.

(5) N. R., Chicago, Ill., asks, What is the best test to tell iron from steel? A. Let fall a drop of nitric acid on steel and it will cause a black spot on it; but if upon wrought iron it will not have this effect. This is a simple and easy method of distinguishing the two.

(6) W. R. S., Chicago, writes, Can you give a method in your paper to make leather stick to iron for the benefit of your readers, and particularly the writer of this? A. Melt together in an iron vessel two parts by weight of common pitch and one part of gutta-percha. This forms a homogeneous fluid, which after being poured into cold water, may be easly wiped dry and kept ready for use.

(7) A. T. N., Kansas City, Mo., writes for a good way to temper drills, chisels, lathe tools, &c., hard? A. Take 5 parts of bismuth, 3 parts of lead and 2 parts of tin, and melt in an iron ladle with a little rosin, place the instrument in an iron tube welded or capped at the lower end; pour in the alloy given above, leaving sufficient room between the surface of the same and stopper or cap at the upper end to allow for the dilation of the contents; bring the pipe to a bright red heat and plunge into cold water. Immediately take off the cap or stopper, and reverse the tube in boiling water. The contents will fall out and the operation is complete.

Business Specials.

Thirty cents a line for each insertion under this head.

The Pratt & Whitney Co., of Hartford, Conn., make a specialty of Cutters for the teeth of gear wheels, that are shaped entirely by machinery and will make interchangeable all gears that are cut with cutters of the same pitch.

For Drop-Forging, Packer Ratchet Drills, Lathe Dogs, Screw Plates and Dies, Address The Billings & Spencer Co., Hartford, Conn.

Frasse & Co., 62 Chatham Street, N. Y. have the most complete assortment of Machine Screw Taps for Machinists, Gunsmiths, Sewing Machine Manufacturers and others, of any house in this country. Also a full line of Chucks, Twist Drills and Fine Tools of every description.

W. H. Warren, Designer and Manufacturer of Special Machinery. Works, 25 Hermon Street, Worcester, Mass.

National Steam Pump, simple reliable and durable. Send for illustrated catalogue with reduced price list. W. E. Kelly & Brother, 46 Cortland St. New York.

Machinery Depot—New, and second hand Iron, and Wood working Machinery and Steam Engines,—E. P. Bullard, 14 Dey St., New York.

The George Place Machinery Agency, 121 Chambers and 103 Reade Sts., New York. Iron Machinery of every description. Patent Cold Rolled Shafting, Pulleys, &c.

The Norcross Steam Damper Regulator, the only reliable pressure Governor in the world, manufactured by The Laflin manufacturing Co., Westfield, Mass.

Combined Hand and Power Planer.

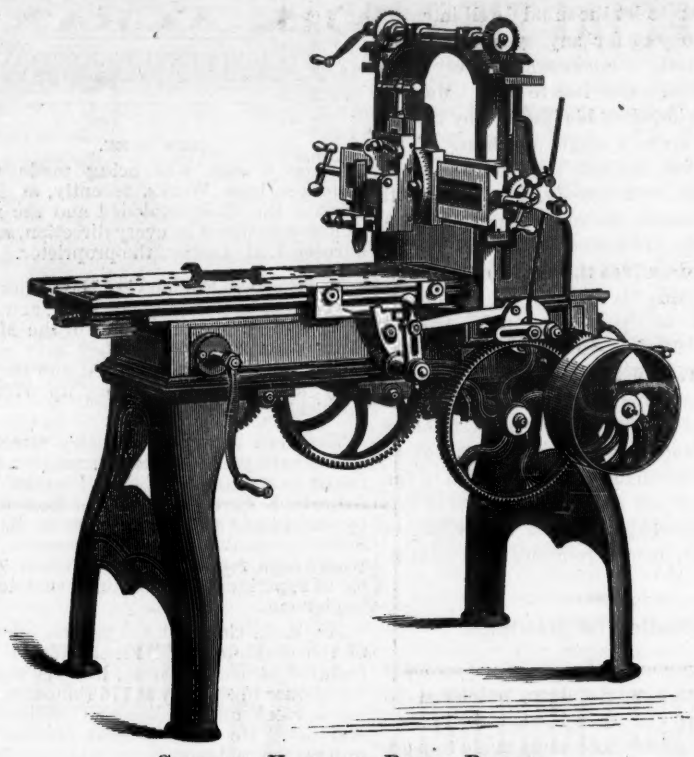
The above cut represents a combined hand and power planer, which can readily be changed from one to the other, only requiring the slipping of one gear out of position, and another in a change that requires less than three minutes of time. They are constructed after the most approved designs of the day, using all cut gearing, and have a cross feed with reversible motion for the same by which feeding can be done in either direction after the work has run back. The table is gibbed down, and the tool post graduated so the machine may cut under any angle desired. The machine will plane 36 inches long, 15 inches wide, and 13 inches high. It is very cheap and well adapted to the wants of those having light work, though it has as much power as many large planers. Several of these planers are in use, giving good satisfaction, and the manufacturers, James A. Sawyer & Son, Worcester, Mass, will furnish any desired information to inquirers.

Reviews.

Electric Lighting.—A practical treatise by Hyppolyte Fontaine; 194 pages, octavo; (Translated from the French). E. & F. N. Spon, London, and 446 Broome St., N. Y.

The above is the title of a new work just come to our table, treating upon a subject that has recently attracted a great deal of notice. To quote from the preface, "Few questions have at the present time the advantage of exciting public attention to the extent of this one." Experiments have been made in nearly every civilized country, on vessels, quays and dockyards, in workshops, harbors, fortifications, railway stations and other situations, to determine the practical value of electric lighting. While many persons have exalted it as being vastly more economical than gas, and almost as intense as sunlight, more, by far, have looked upon it with a kind of old fogy aversion, choosing to treat it rather as an ephemeral fancy like the blue glass craze.

The object of this work has been to present in a clear matter-of-fact way what has been demonstrated by the most careful trials, and the means that have been employed to accomplish the results so far established, as well as to point out errors that have obtained upon this subject. Numerous engravings are shown, and the most successful systems are well explained. Many large workshops that are run at night are now lighted by electricity with general satisfaction, and the volume before us will prove of great value to those contemplating the introduction of this kind of illumination.



Combined Hand and Power Planer.

Our Exchanges.

The Chicago Journal of Commerce has lately been enlarged to a twenty page issue, 17½x 13 inches, making it the largest weekly newspaper we know of, published outside of the city of New York. Its editorials are vigorous and pointed, its market reviews and quotations very full and comprehensive, and its advertising columns well filled with cards of representative establishments, all of which goes to show that the managers are imbued with the Western "Git up and git" spirit. We wish it continued success.

The Railroad Gazette is the leading journal of railroad business in the United States. It gives, in systematic style, the fullest railroad news, practical discussions of leading railroad topics, illustrated descriptions of new inventions belonging to its specialty, a weekly record of new railroad construction, and much other valuable information. No more independent and thoroughly conducted mechanical journal is published in this country.

The Texas Weekly News and Railway Review is the name of a weekly journal just started at Palestine, Texas, by R. R. Gilbert. It is the only railroad sheet published in the Lone Star State, and is a creditable enterprise in journalism.

We have received one number of a new monthly journal, entitled *The True Citizen*, issued by the Mercantile Journal Co., of this city, at $1 a year. It is devoted to the advocacy of "Greenbacks and plenty," as opposed to Contraction and labor oppression. It treats the subject in an argumentative way, avoiding brainless vituperation, and is an able exponent of the paper-money system of finance.

Iron Trade Circular (Ryland's), of Birmingham, England, is a 32 page weekly journal of the iron and hardware trades of Great Britain. It contains the price lists of the leading iron manufacturers of the United Kingdom, corrected for each issue, and carefully prepared reviews of the trade; also, other current information on metallurgical subjects. It is the most valuable journal we know of for those who wish to keep correctly posted on the English Iron trade.

An Ohio genius recently exhibited at Columbia, Pa., an iron man who walks by steam. The iron man walks on a circle of boards, about seven feet in diameter, and is moved by two little engines in his chest, to which steam is communicated from a boiler by pipes through his hands and arms. In his mouth is a tin tube through which the exhaust steam escapes.

The importation of railroad iron into this country during the year 1873 was, in round numbers, $20,000,000. It has now fallen off to less than a thousand a year, or, practically, to nothing.

—It is difficult, says a Belgian journal, to distinguish between iron and steel tools. They have the same polish and workmanship; use will commonly alone show the difference. To make the distinction quickly, place the tool upon a stone and drop upon it some dilute nitric acid (four parts of water to one of acid.) If the tool remains clean it is of iron; if of steel it will show a black spot where touched by the acid. These spots can be easily rubbed off.

Machinists' and Engineers' Supplies.

The trade is fair, but not driving, for the season. Standard goods are in ordinary demand, but novelties are not much wanted. The Pratt & Whitney Co. are about to bring out a full line of taps for machine screws. By mistake in arranging the price list of the Prosser Boiler Tube Expander in our last, some misunderstanding arose. The following is the correct arrangement of prices:

Price List Prosser Expander.

Outside Diameter of Tube, inches. Spring Expanders, each.

1	1¼	1½	1¾	2	2¼	2½	2¾
$8.	8.	9.	11.	12.	13.	15.	1[illegible]
3	3¼	3½	4	4½	5	6	7
$22.	26.	30.	33.	37.	42.	60.	75.

A discount is allowed from above list, which will be made known on application. In ordering expanders the thickness of the tube plate should be given.

Boiler-Makers Supplies.—Trade is fair in amount, but prices are not satisfactory. No change since our last. Tank Iron @ 2¾; C, No. 1, @ 3; Shell @ 3¼; Best Flange @ 4½; Soft Patch @ 6½; Boiler Rivets @3¾; Boiler Tubes list price less 40% discount. Mill prices furnished on application.

ENGINES INDICATED AND EXAMINED,

POWER MEASURED,

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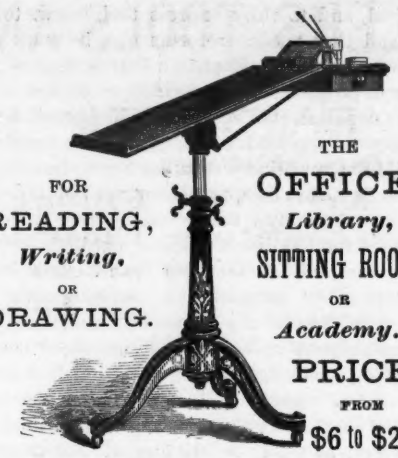

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By HENRY B. ALLEN,

Author of "Engineers' Catechism," "Perfect Instructor in Telegraphy," "Piano-Forte Tuners' Guide," and other Scientific and Mechanical works.

Prof. A. E. Wilson, that great engineer and scientist, says, "I buy no books that I see advertised unless they are strongly "recommended." Read the following recommendations (and we have hundreds more):

"It is a plain, practical work for every-day use in the shop, "and will be found valuable alike to apprentices and skilled "workmen. It avoids algebraic formulas and mathematical "problems, while giving in available form such information as "machinists, engineers, and other artisans should acquire. The "price is low enough to bring it within the reach of everybody." —American Machinist.

"This work is very reliable, and is strongly recommended by "this paper. It is one of the most comprehensive works ever "published. The greatly condensed Table of Contents printed "in this paper gives but a very faint idea of the enormous "amount of exceedingly valuable information that this book "contains. It is undoubtedly the cheapest work of the kind "ever published. It contains between 700 and 800 large pages "of closely arranged matter. The author and compiler has "covered very extensive ground, and the recipes and instructions are carried down to the latest date. The name and well-"known reputation of the author is a sufficient guarantee of its "value."—Scientific American.

We want a few more live agents, such as the following-named, viz.:

J. S. BALDWIN sold in Newark, N. J., last month, 987 copies.
S. P. WILSON sold in Paterson, N. J., last month, 381 "
J. B. RICHARDS sold in Rahway, N. J., last month, 379 "
ROBT. H. SMITH sold in Yonkers, N. Y., in a few days, 200 "
Robt. H. Smith sold 79 copies in one day.
All agents who take hold of this work do well.

Among the multitude of subjects of which it treats, will be found the following: Telegraphy, of which it is a perfect self-instructor, teaching the construction, manipulation and management of Instruments, Batteries, Wires, &c., Reading by sound, The Learner's Instrument, How to learn telegraphy at home in a short time. One Hundred and Fifty valuable Mechanical Movements, Illustrated and Explained. Information concerning Patents; how to obtain them. Tuning the Pianoforte, Organ, Melodeon, a complete self-instructor, Watchmaking, the whole process of manufacture in detail. Watchmakers' Train Tables. Directions for the construction and management of Engines, Boilers, Gauges, Valves, &c. Duties of Engineers. Cements for Steam work, Composition Boiler Covering, Steam packing, Scale preventatives, Polish for bright work; Useful hints for Millers and Millwrights; Saw Mills and Shingle Machines, Rules for speed of Wheels, Pulleys, Drums, Circular Saws, &c.; Saw filing, full directions; Mending Broken Saws, Shafting, Belting; Gear Cutting, Bevel Gears, Friction Paper Pulleys, Screw work, Planing, Boring, Turning, Finishing, &c.; Making and Tempering Railway and Carriage Springs, Saws, Axles, Steel Ploughs, Files, Taps, Reamers, Cold Chisels, Marble and Stone Cutters' Tools, Stone Drills, Dies, Mill Picks, Edge Tools, Scissors, Razors, Scythes, Gun Lock Springs, Watch Springs; Emery Wheels, different kinds; Tempering Liquids, 7 kinds; Metallic Tempering Bath; Case Hardening, 6 ways; to Restore Burnt Steel, 4 ways; Annealing Steel, &c. To toughen and improve poor Steel and Iron; to Reduce Oxides; Alloys for Gold, Silver, Brass, Bronze, German Silver, &c., 350 kinds; Solders, 75 kinds; 100 Compositions for Locomotives, Organ Pipes, Pumps, Telescopes, Plated Goods, Gongs, Cymbals, Metals, &c., &c.; 26 receipts for Tinning, Blueing, Galvanizing, Coppering, Brassing, Zincing, and Enameling on metals; 77 receipts for Bronzes, Dipping Acids, Lacquers, Paints, Japans, &c., for metal work. Bronze Powder, 9 kinds. 24 receipts for Coloring, Gilding and Plating; 375 very valuable receipts for Watch, Chronometer, Clock and Jewelry work. Over 1 00 reliable processes for Iron, Steel, Saw, Tube, Chain, Anvil, Sewing Machine, Gas fixture, and Fire-arm Manufacturers, Master Mechanics, Machinists, Engineers, Blacksmiths, Horseshoers, Carriage Makers, Iron, Brass, Type and Bell Founders, Pattern Makers, Refiners, Gunsmiths, Cutlers, Millwrights, Coppersmiths, Gas and Steam Fitters, Plumbers. Marble workers, Opticians, Die sinkers, Stencil cutters, &c. Glass, Glass Staining, Etching, and China Decoration, 50 receipts. To Gild Glass Signs, 5 ways; Stains for Wood, Polishes, Wood filling, Oil Finishes, 100 kinds. 500 receipts for House, Sign, Shin, Carriage and Ornamental Painters, Grainers, Cabinet and Musical Instrument Makers, Gilders, Carvers, Polishers, Picture Frame Dealers, Varnishers, Stucco Workers, &c.; 40 receipts for Cement and Glue. 60 receipts for Tanners, Boot, Shoe and Harness Makers. 150 receipts for Dyers, Bleachers, Hatters, Clothiers, &c. For Dentists, 25 receipts; Moulders', Pattern and Model Makers' Tables, Weights of Iron, Steel, Brass, Copper, Lead, Russia Iron, Lead Pipe, Strength of Cast Iron Columns, &c., at sight. Estimates of Supplies for Lumber Camps. Estimates for Masons, Plasterers and Contractors. Diagrams for Machinists. Full instructions for making Artificial Flowers, Fruit, &c., for taking Ferrotype, Tintype, and other positive pictures; for Making, Bottling and preserving all kinds of Ales, Wines, Spirits, &c., 150 receipts. For manufacturing Confectionery of all kinds, 120 receipts. The whole Art of Brewing; Cage Birds and their Diseases, Taxidermy; Rules for the Games of Billiards, Pool, &c. Book-keeping, by both double and single entry, condensed and comprehensive; valuable information for Farmers, in regard to Horses, Cattle, Poultry, Composts, &c. More than 1100 receipts for Cooking, Baking, Preserving, Pickling, &c. There is so much that is valuable in this work that we can give only a faint idea of its contents.

This valuable work can be obtained at our Publishing House or will be sent by mail, postage paid, on receipt of $2.50. (When change is not handy, send postage stamps for the odd 50c.) (☞ We also have this work in Fine Leather Library Binding—a magnificent book—price $3.00.) First-class Canvassers wanted. Liberal Commissions paid. H. B. ALLEN & CO., Publishers, 33 Murray Street, New York. P. O. Box 3756.

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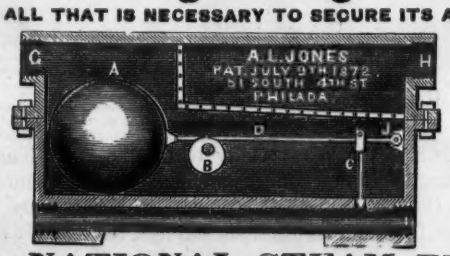

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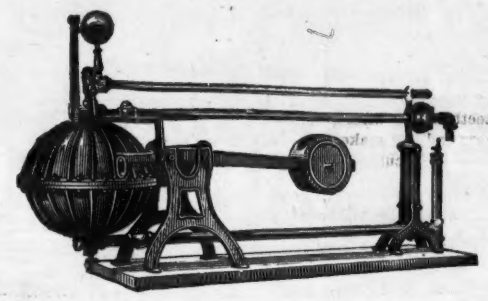

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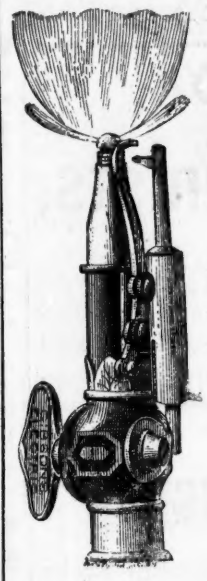

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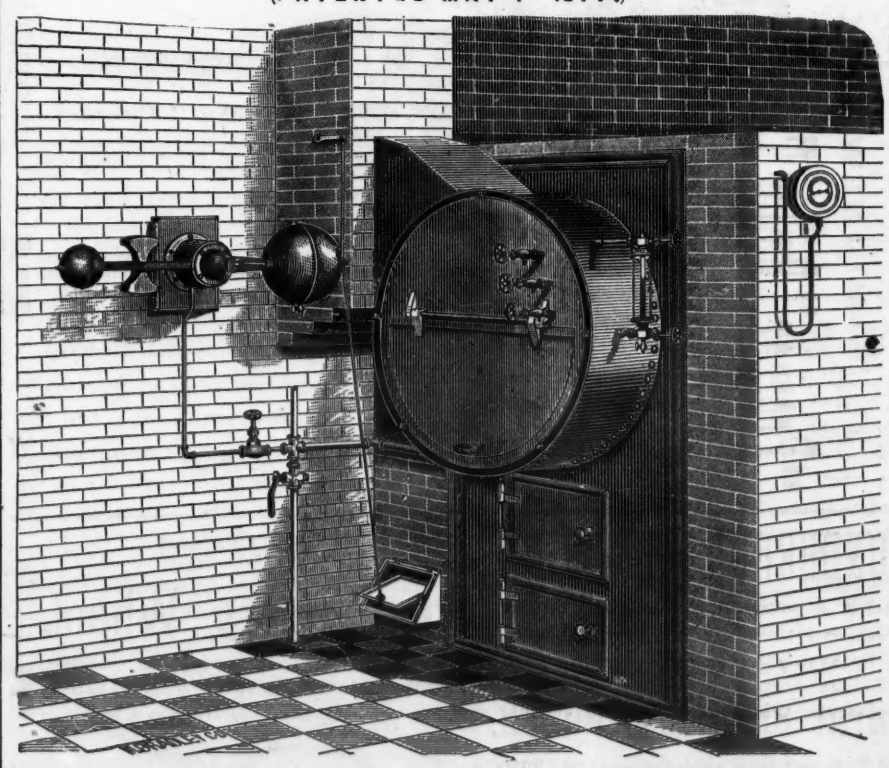

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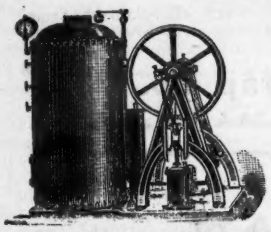

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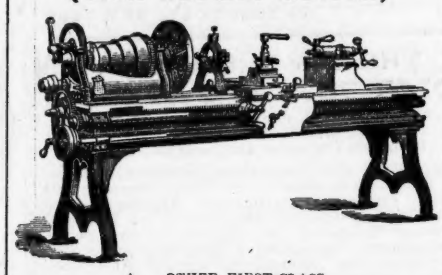

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⅝×16	14	12	10	3/16	¼ & 5/16
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7/16	6/10	3¼ to 3½	6 10/10
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⅜×¼ and ⅜ 1 1/10	¼ and 5/16 ⅛ 10/10	⅜ to ½ 6/10
⅜×¼ and ⅜ ⅛ 10/10	¼ and 5/16 6/10	⅜ to ⅝ 4/10
⅞×¼ and ⅜ 4/10	¼ and 5/16 ⅛ 10/10	⅜ to ¾ ⅛ 10/10
1×¼ and ⅜	¼ and 5/16	⅜ to ⅞

4/10	⅛ 10/10	⅛ 10/10
1⅛×⅛ and ⅜ 1/16	¼ and 5/16	⅜ to 1
1¼ to 4½×¼ and 5/16, ×1⅛ to 2		⅛ 10/10
4⅜ to 6×⅜ to 1, 4⅜ to 6×¼ and 5/16 ×1⅛ to 2		4/10
6¼ to 7×⅜ to 1, 2¼ to 3×2⅛ to 2¾, 6¼ to 7× ¼ and 5/16 ×1⅛ to 2, 3¼ to 4×2⅛ to 3		6/10

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4/10	6/10	4/10	⅛ 10/10
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" Tool Steel,	13
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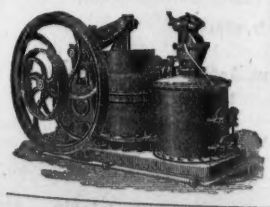

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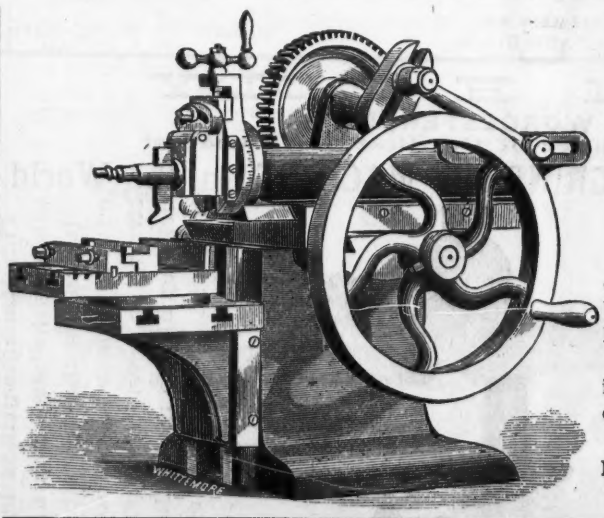

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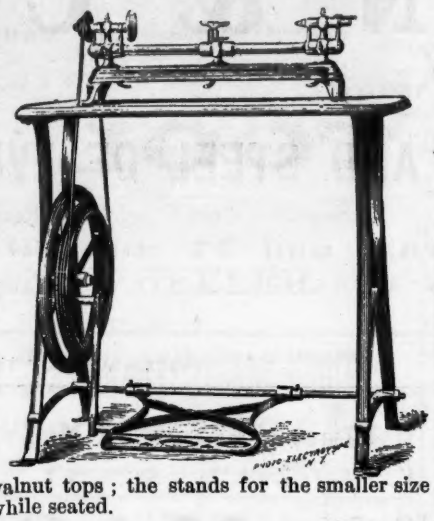

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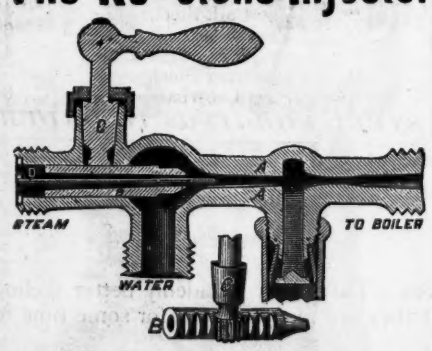

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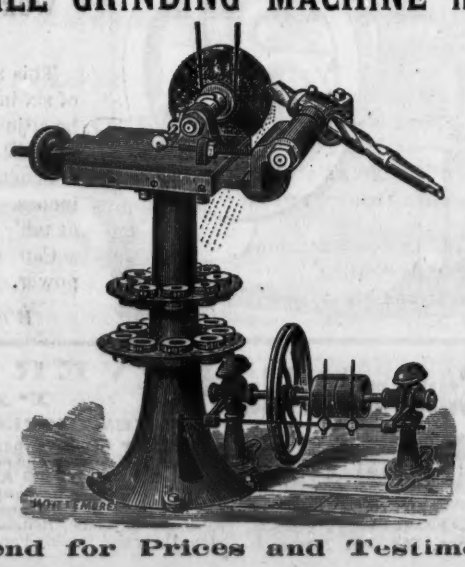

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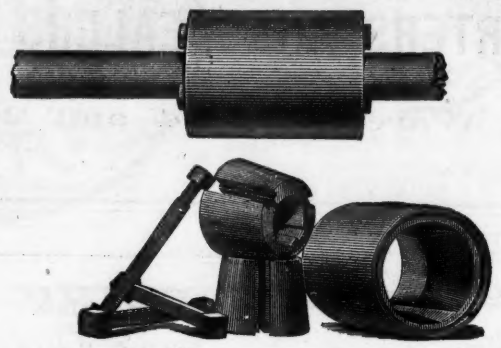

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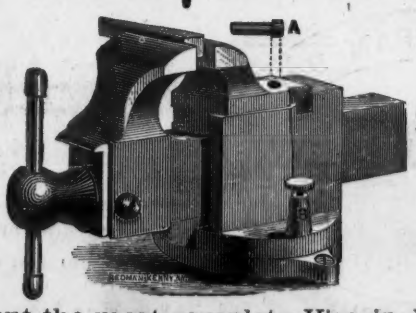

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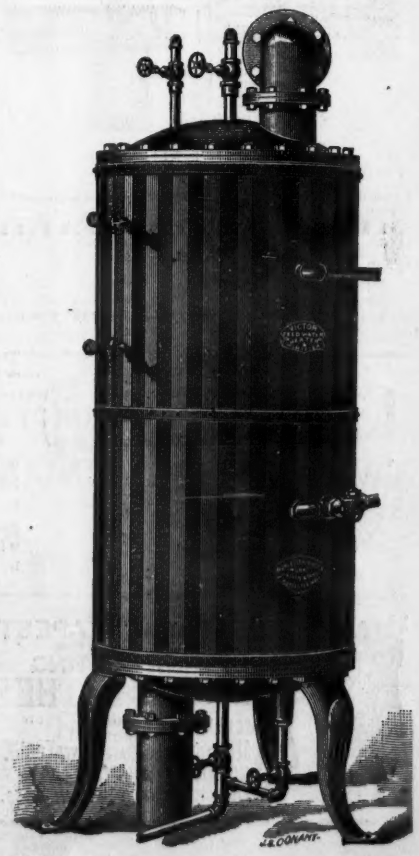

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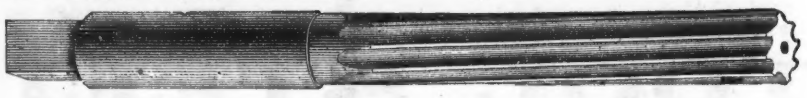

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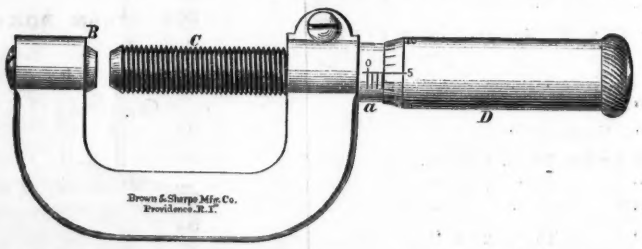

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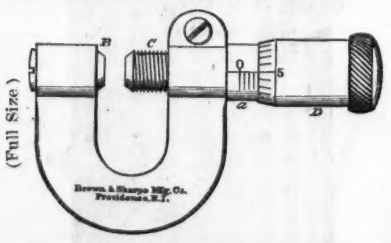

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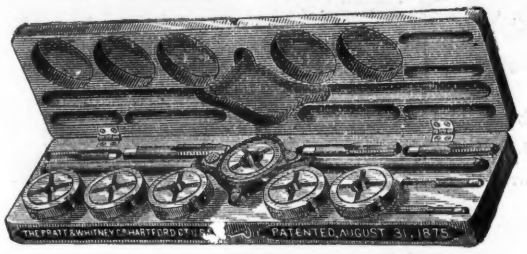

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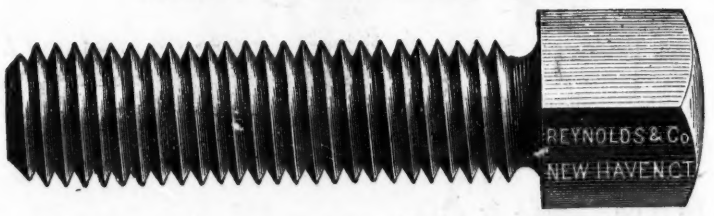

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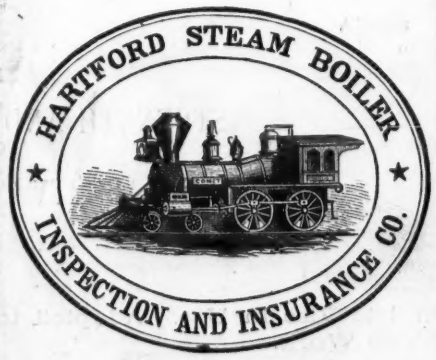

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